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THE TORONTO AREA RAIL TRANSPORTATION OF DANGEROUS GOODS TASK FORCE

FINAL REPORT

Canada

Cover Acknowledgement

The report cover shows an extract from a letter written by George Stephenson (1781-1848) to the Right Honourable H. Labouchere, President, Board of Trade (U.K.). Mr. Stephenson is known as the 'father of the modern railway system'. His letter concerns the need, even in those days, to ensure that the technological and human elements of the railway system were properly co-ordinated.

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■ Reid+Reid	graphics & layout
■ A.J. Freedman & Associates	drafting assistance
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■ Queen's Printer	printing
■ Secretary of State	translation

July 1988

Letter of Transmittal

The Honourable Benoit Bouchard, P.C. M.P.
Minister of Transport
Transport Canada Building
Place de Ville, Tower C
25th Floor,
330 Sparks Street
OTTAWA, Ontario
K1A 0N5

Dear Minister:

It gives me great pleasure on behalf of the Toronto Area Rail Transportation of Dangerous Goods Advisory Council (Task Force) to present you with our Final Report.

In March, 1986, the Task Force was appointed to conduct a comprehensive examination of the flow of dangerous goods through the Toronto Area rail network and to report to you on our findings, conclusions and recommendations. Our mandate was to report on options to improve public safety and their related costs. Specifically we were to inquire into and report on the feasibility of rerouting or relocating rail traffic transporting dangerous goods as well as examining additional safety requirements.

Now, two years later, we have come to the end of what my colleagues and I believe has been a most comprehensive study - probably the most extensive of its kind ever undertaken. This has involved an extraordinary range and depth of work, particularly where it required a good deal of original research to address the concerns of those who have a deep and abiding interest in enhancing public safety.

We hope that our recommendations will assist you in advancing the cause of public safety in the transportation of dangerous goods by rail.

Respectfully,

Harold Gilbert

Harold Gilbert,

Chairman

Acknowledgements

It would be impossible for us to list individually the names of all those persons and agencies who have contributed to the work of the Toronto Area Rail Transportation of Dangerous Goods Task Force.

We wish to thank the regulatory, investigative, research and railway operating agencies in the United States, the United Kingdom, West Germany, Finland, France, The Netherlands, Sweden, Denmark, Norway, Australia and Japan who unstintingly shared with us their experience in a number of areas. In particular we would like to thank the U.S. Federal Railway Administration; the U.S. Research and Special Projects Administration; the Association of American Railroads; the Cities of Chicago, Ill., Boston, Mass., Houston and San Antonio, Texas; British Rail; the British Department of Transport, and the British Health and Safety Executive. To those who were kind enough to take time to meet with us personally - a special word of thanks.

Many diverse organizations responded to our request for briefs to the Task Force. Representing manufacturers, producers, shippers, unions, trade groups, professional organizations and the research community, all have made a singular contribution to our understanding of the complex issues involved in transporting dangerous goods by rail. We would especially like to acknowledge the extensive cooperation received from the Canadian railways. Their suport was enormous, unstinting and unequivocal.

To the members of the public who, as individuals or as community groups, took the trouble to make their views known, we owe a particular debt. They did much to inform us about how the general public may be affected in the future by the recommendations we are making. Our mandate would not have been met had we been unable to exchange such views frankly and frequently.

We would like to express a particular appreciation to the many directorates, branches and personnel of Transport Canada, the Canadian Transport Commission (The Railway Transport Committee), Secretary of State, the National Research Council, the Transport Development Centre, and the Ministries of the Ontario Government - in particular the Ministry of Transportation, for their unquestioning support, administrative help and encouragement. Our thanks are also extended to those 'home' companies and organizations in which many of us perform our daily duties. Without their patience and support, we would not have been able to devote the time needed to this important topic. We are most grateful.

Finally, to our staff, and in particular Mr. E.J. (Ted) Legg, Executive Director, and Mr. L.R.(Rie) Kidman, Project Director, a very special word of gratitude. Their day-by-day professional support of the Task Force has been of tremendous assistance to us in carrying out our mandate.

To all, we are deeply indebted and sincerely appreciative.

The Toronto Area Rail
Transportation of Dangerous Goods
Task Force

The Toronto Area Rail Transportation Dangerous Goods Task Force

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**Mr. Drew was replace by Mr. B. Buchanan on 1 August, 1987 and then by Mr. B. Lee on 22 February 1988.*

Report Summary

The Toronto Area Rail Transportation of Dangerous Goods Task Force

Preface

The Minister of Transport established the Toronto Area Rail Transportation of Dangerous Goods Task Force in March, 1986. This Summary Report provides an overview of our Final Report to the Minister, outlining our major observations, conclusions and recommendations.

Our conclusions are based on what we believe has been the most comprehensive study of the transportation of dangerous goods by rail ever undertaken. We would like to thank the many organizations, countries, elected officials and consultants who made this study possible. In particular, we would like to thank our staff and the members of the public who, as individuals or as groups, took the trouble to make their views known. Our work could not have been completed without their help.

Our study took two years to complete and examined a wide range of complex rerouting, relocation and safety issues. Summarizing such a work tends, by necessity, to simplify the depth of thought and discussion behind our final conclusions and recommendations.

We urge anyone seeking more detailed information on our study to consult our full Report, and the 13 volumes of working papers which include:

- Summary of Consultants' Reports
- Public Perception Survey Study
- Routes Study
- Risk Assessment Study
- Risk Management Study
- Speed Study
- Technology and Safety Administration Study
- Buffers Study
- Land Use Study
- Emergency Preparedness and Response Study
- Public Submissions (including analyses)

Requests for information on how to obtain any of the above should be addressed to:

Mr. Michael Salib
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Dangerous Goods Directorate
The Canada Building, 14th Floor
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Ottawa, Ontario
Canada K1A 0N5
(Tel. No. 613-990-1132)

All but one member of the Task Force have given their support to this Summary Report.

This has been a challenging assignment. The focus of our concern has been Canada's largest metropolitan region — one where any accident involving dangerous goods could put the health and safety of large numbers of people at risk. We are pleased to have been able to contribute our services.

Toronto Area Rail
Transportation of Dangerous Goods
Task Force

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1.0 Introduction and Background

1.0 Introduction

Transportation of dangerous goods by rail is not a new phenomenon, but in recent years it has caused increasing public concern. The 1979 Mississauga derailment of a train carrying propane and chlorine, which caused the evacuation of almost a quarter million people, is one reason for this concern, but it is not the only one. Other rail accidents, the Bhopal chemical accident in India, and the Chernobyl nuclear accident in the U.S.S.R. have all heightened public awareness of the risks involved with dangerous substances.

In March 1986, the Minister of Transport established the Toronto Area Rail Transportation of Dangerous Goods Task Force. We were asked to enquire into:

- the feasibility of rerouting or relocating rail traffic carrying dangerous goods in the Greater Toronto Area; and
- any additional requirements governing the safe transportation of dangerous goods by rail.

1.1 Definitions

Dangerous goods are products which, if released in a rail accident, can have a harmful effect on humans, animals and the environment. There are over 3000 of these products - all classified under a system established by the United Nations and expanded to meet North American requirements.

For this Summary Report, three simplified classifications have been used:

- **Special Dangerous Commodities** - which include substances such as explosives, toxic or corrosive gases and liquids, and which could cause significant harm beyond the immediate rail right-of-way if released (i.e., chlorine, propane, and anhydrous ammonia).
- **Dangerous Commodities** - which include substances which generally cause harm only within the right-of-way if

released (i.e., gasoline). Some of these products may cause harm beyond the rail right-of-way.

- **Dangerous Goods** - which include both Special Dangerous Commodities and Dangerous Commodities.

1.2 Interpreting Our Mandate

A narrow interpretation of our mandate might suggest a purely technical task — examining the feasibility of rerouting or relocating rail lines from an engineering or operational point of view.

However, we did not interpret our mandate in this way. We were asked to examine 'feasibility' in the widest possible context, and to determine the economic and social costs or benefits involved in rerouting or relocating rail traffic. In our view, this meant we had to look at the way different rerouting or relocating options would reduce — or increase — the risk to public safety. Rerouting as an engineering exercise in itself would be of little interest.

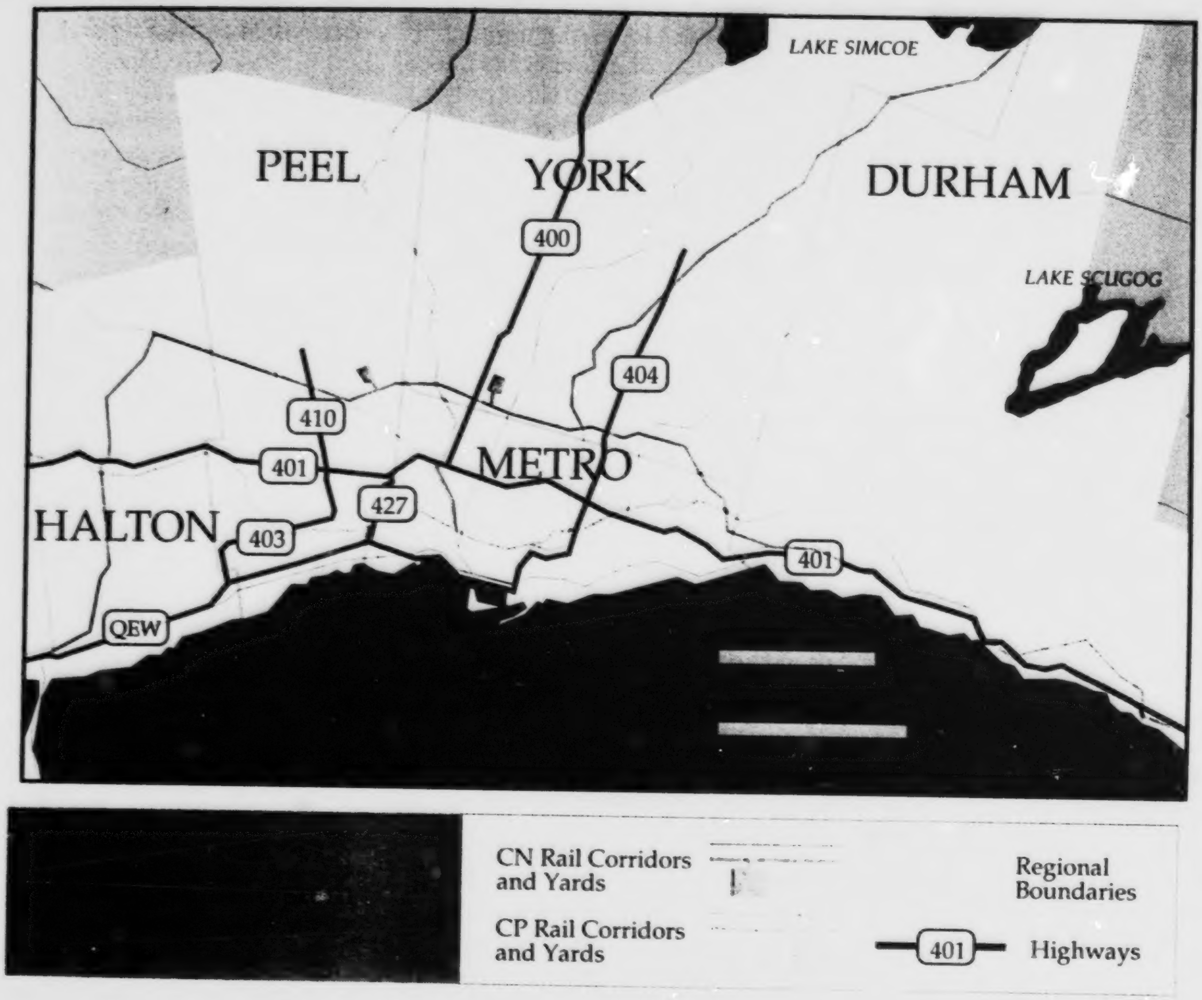
In fact, we felt that our mandate was first and foremost one of **public safety**. Rerouting or relocating were considered only as possible means to that end. We realized that many other things could and should be done now to enhance public safety, whether or not rail lines were rerouted or relocated at some later date. We could not do our job if we limited our attention to rerouting and relocating alone.

Our mandate focused on the rail system in the Greater Toronto Area, as shown in Exhibit S-1. But the rail system in Canada is a continuous network from coast to coast. It would be difficult for one part of the system to be safe, if the system as a whole is unsafe. This meant we had to consider more general questions about how railways operate, and how they are regulated in Canada.

1.3 Methodology

We commissioned a number of Consultants to assist us in examining a variety of issues; their reports were invaluable, and are available as separate volumes.

We also carried out extensive studies on our own. We sent questionnaires to eleven countries and fifteen States in the USA We held discussions with the regulatory and rail inspection personnel in Canada, the USA and Great Britain. We toured the rail network in the Greater Toronto Area and visited some of the best railway laboratories and testing facilities in the world.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CN Rail Corridors and Yards
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CP Rail Corridors and Yards
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Highways

We also maintained a continuous public consultation program. We heard 64 presentations; received 125 submissions; and held widely-advertised public information sessions, followed by a further two days of public hearings. Municipal and Regional Councils were briefed twice, and elected officials were continuously kept informed through periodic progress reports.

1.4 Report Overview

Part 2 of this Summary deals with the fundamental question of public safety and confidence in the way the transportation of dangerous goods by rail is managed. This was the one issue that dominated our deliberations right from the beginning. There is a severe communications gap between the general public and both the Regulator and the railways. We outline a number of measures to help close that gap, and ensure greater public accountability in rail safety.

Part 3 looks at a number of alternatives for rerouting and/or relocating dangerous goods rail traffic in the Greater Toronto Area. None of these options however would achieve dramatically lower levels of risk throughout the entire system when compared to that of the existing system. Consequently the majority of the Task Force believes that insufficient justification exists to warrant rerouting part of the system on the basis of risk reduction alone. However, rerouting should be considered in the context of a more comprehensive rationalization of the rail system, and plans must be made for its future development.

Part 4 identifies a wide range of opportunities for improving the safety of the existing rail system.

1.5 Conclusion

Regardless of which steps are taken, it is our view that everything that can be done to improve public safety, should be done. We hope that our deliberations on this important topic will advance the cause of public safety.

2.0 Public Safety

2.1 Public Confidence in Rail Safety

The question of public confidence in rail safety was not specifically mentioned in our mandate. But from the moment we began our consultations, this question and that of public safety were raised repeatedly.

When trains are carrying dangerous goods, and in particular through high density urban areas, the public wants to be assured that everything that can be done is being done to ensure safety. From our findings, it appears that the public does not feel confident that this is the case, despite the fact that Canada's railways have one of the best safety records in the world — and despite the fact that there has never been a fatality due to a dangerous goods rail accident in Canada. We have concluded that the reason for this lies, in large part, in the failure of those regulating and operating the railways to communicate effectively with the public in regard to the improvements that have been inplemented and are continuing to take place within the rail system.

2.2 Regulation and Accountability

To understand how Public Safety is addressed by both the Regulator and the railways, we examined the structures and mechanisms in place governing the rail flow of dangerous goods. This examination included not only the past and present regulatory requirements, but the future requirements as outlined under legislation now being implemented. We also reviewed regulatory requirements in the USA and Europe.

We found that in Canada, regulation has tended to be a costly and time-consuming process. Regulation has been achieved by issuing detailed specifications and operating requirements, rather than by setting clearly defined safety objectives. The public has been confused by a highly-centralized, single regulatory inspection and accident investigation body, which gave the impression that there were insufficient checks and balances in place to ensure effective and impartial monitoring.

While the general public's knowledge concerning the rail flow of dangerous goods is very low, the concern regarding a rail accident involving such products is quite high. There is a real need on the part of the public to learn more, but neither the Regulator nor the railways appear (until recently) to have recognized this need. Certainly the need has not as yet been satisfied.

We found that databases, from which critical decisions are made, are inadequate and incomplete.

We also found that a great deal of railway Research and Development is taking place within the railways (both in Canada and the USA), but that this Research and Development is uncoordinated. As a result of this (rather than because of funding problems, we would suggest), facilities are not used to their full capacity, and Research and Development is not priorized in the interest of public safety.

We found that the railways have established procedures to attempt to manage the large volume of rail traffic which flows daily back and forth across the Canada/USA border. But there are no formal, governmental mechanisms in place on the part of the Regulators.

In general, we found that many changes need to be made in the regulatory and monitoring area governing the rail transportation of dangerous goods. It is our view that the regulatory process must not only be objective and operating in the public good, it must also be seen to be doing so.

2.3 Recommendations

Our recommendations in this area are:

Public Safety

Who manages Safety in Canada

- The Minister of Transport, as the National Transportation Safety Manager, be fully committed to ensuring the safe operation of Canada's rail system and that this commitment be publicly seen.
- Safety be assigned top priority in the transportation of dangerous commodities and that the promotion of safety be publicly tangible, visible and paramount.

The Need for National Safety Targets

- National Safety Targets, developed in conjunction with the railways, and expressed in percentage terms (i.e., reduce rail accidents by X% a year), be established, promoted and monitored by the Minister of Transport and that an accounting of the progress made towards this objective be given to the public from time to time.

- The Minister of Transport, in establishing these safety objectives, place before the public the Canadian railway safety record compared with that of other jurisdictions and modes of transportation, so that an accurate and fair judging can be made.

Separation of Regulatory Functions

- The legislation required to complete the separation of regulatory, safety inspection and accident investigation functions concerning the railways be given utmost priority.

The Need for a Centralized, Multi-Modal Dangerous Goods Data Base

- A comprehensive, ongoing review of dangerous products designation and classification be undertaken.
- Transport Canada's Dangerous Goods Directorate be the only agency charged with compiling and promulgating the master classification listing (including special commodity designations) of all dangerous goods offered for transport.
- Transport Canada's Dangerous Goods Directorate be given sole responsibility to establish accident and incident reporting criteria in conjunction with the user agencies.
- A centralized data base on the transportation of dangerous goods containing similar data elements between Canada and the United States, and maintained by each country's respective Regulator, with accessibility rights of others, be established.

A Joint Canada/U.S.A. Commission to Establish Common Cross Border Standards

- A joint Canada/USA Rail Commission be established to ensure the formal communication necessary to facilitate uniform safety standards governing the cross-border flow of rail cars between Canada and the USA and that this Joint Commission be mandated to work to improving the standards, thus improving safety.
- Representation on this Commission be made up of five persons - one each representing the Canadian and USA Regulators; one each representing the American railroads (AAR) and the Canadian railways (RAC); and one neutral chairperson.

Establishment of a Permanent Advisory Council on the Rail Transportation of Dangerous Goods

- An Advisory Council, reporting to the Minister of Transport, on the Rail Transportation of Dangerous Goods be made permanent and be so constituted in its membership as to fully represent all interested parties, including, to a significant degree, the general public.

- The Advisory Council on the Rail Transportation of Dangerous Goods be required to work closely with the Consultative Committee proposed in the new Railway Safety Act (Bill C105).

Co-ordinated Regulatory Research and Development

- The Regulator have the capability of understanding, using, co-ordinating and, where necessary, undertaking Safety Research and Development as an aid to the promotion of public safety.

The Need for an Independent Safety Audit Function

- An Independent Operational Safety Audit function be established with a broad mandate for safety of transportation involving the rail system, the findings of which must be open to full public scrutiny.
- The Independent Operational Safety Auditor report directly to the Minister of Transport, in the same way as an internal auditor.
- Findings of the Independent Operational Safety Auditor be made available to both the regulatory and accident investigation functions as well as any railway, shipper, receiver or other parties audited for subsequent action.
- Steps be taken to ensure that the duties of the Operational Safety Auditor remain, and are seen to remain, separate and distinct from those of the Regulator and that this audit role not be perceived as an encroachment on the regulatory function.

Speeding Up Accident Reports

- The federal Regulator ensure that investigations into dangerous goods accidents are initiated promptly; that the 60-day deadline for issuance of the results is met, and that follow-up action on deficiencies or faults shown in the investigator's report is launched without delay.

Private Sidings — A Responsibility Gap

- The Railway Safety Act be amended to allow the Regulator to inspect all federally regulated railway cars, especially tank cars, regardless of their status.

Communications and Community Interface

■ The railways should pay more attention to community information exchange and cooperation in order to provide greater assurance and appoint, as a normal business expense, a coordinator who would interface with municipalities and residents' Associations on an ongoing basis.

■ Regional Municipalities within the Greater Toronto Area individually or collectively appoint a coordinator(s), at a senior level, who would interface with the railways and community groups.

■ The railways, the Province of Ontario and Municipalities/ Regions establish, at a senior level, a formal liaison committee mechanism through which issues can be discussed and resolved.

■ Governments, at all levels, and the railways promote and encourage an increased level of knowledge and communication within the general public in the area of the transportation of dangerous goods by rail.

3.0 The Analysis of Routing Alternatives

A Longer Term Option

3.1 Routing Alternatives

At the outset of our study we identified six options for rerouting and/or relocating the rail flow of dangerous goods in Greater Toronto. However, an initial screening ruled out three of these options because of excessive costs; because of their detrimental environmental and community impacts; but most importantly because of the lack of benefits in terms of reducing risk to the public. This left us with the following three options for further study:

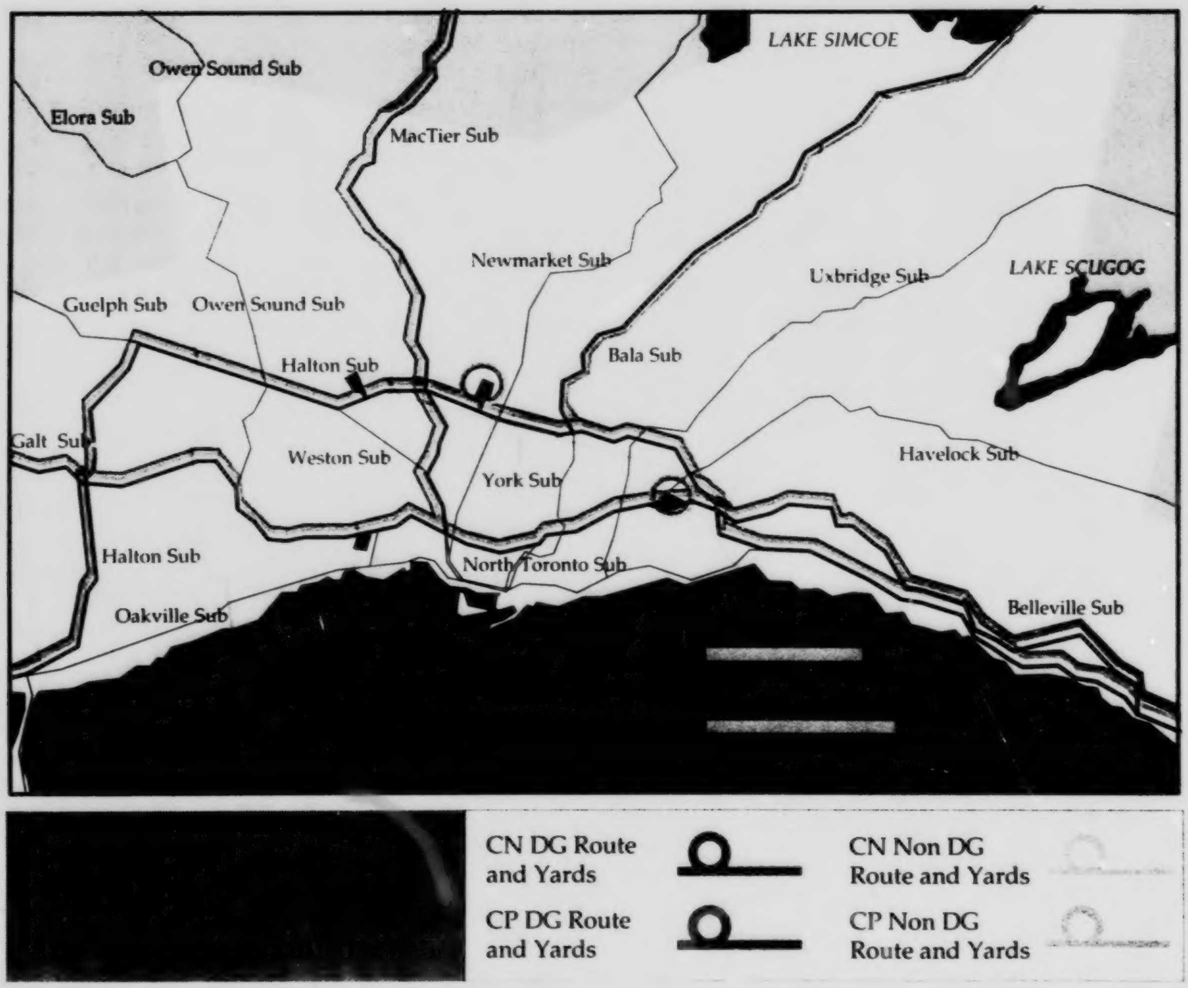
i) **The Existing System Corridor option:** - under which Canadian Pacific's dangerous goods traffic would continue to move east-west through the middle of Halton and Peel Regions; through midtown Metropolitan Toronto; and through the south of Durham Region while Canadian National's dangerous goods traffic would continue to move through Halton and Peel Regions, the southern part of York Region (just north of the Metropolitan Toronto boundary) and the south of Durham Region. Dangerous goods traffic to and from Western Canada would continue to move north-south via the MacTier Subdivision in the case of Canadian Pacific and via the Bala Subdivision in the case of Canadian National.

ii) **The Parkway Belt Corridor option:** - under which both Canadian Pacific's and Canadian National's dangerous goods 'through' traffic would be rerouted into the Parkway Belt. This corridor was established as a transportation/utility right-of-way by the Ontario Provincial Government during the 1960s and 1970s on an east-west alignment immediately north of Mississauga and Metropolitan Toronto. This corridor is now occupied by hydro towers, underground utilities and the recently initiated Highway 407. This option would utilize some existing Canadian Pacific and Canadian National trackage but would require some new rail line as well.

iii) **The North Corridor option:** - under which a completely new rail line would follow a more northerly alignment through the north of Halton and Peel Regions, travel through the middle of York Region and then either the north or south of Durham Region depending on the sub-option chosen. This corridor option would avoid major existing, and planned, urban development to the year 2011, on a new rail line, and would have to be some 60 - 80 kilometers in length.

3.2 The Existing System Option

The existing system provides a benchmark against which other options can be measured. The existing system has operated efficiently; it is well maintained; and it is serving the community it was designed to serve. We also concluded that the existing system would have to be retained for local traffic, even if 'through' traffic was rerouted to some other option.
We studied one sub-option within the existing system, in which Canadian Pacific's dangerous goods through traffic would be rerouted onto Canadian National's Halton and York subdivisions. The Existing System sub-options are illustrated in Exhibits S-2 and S-3.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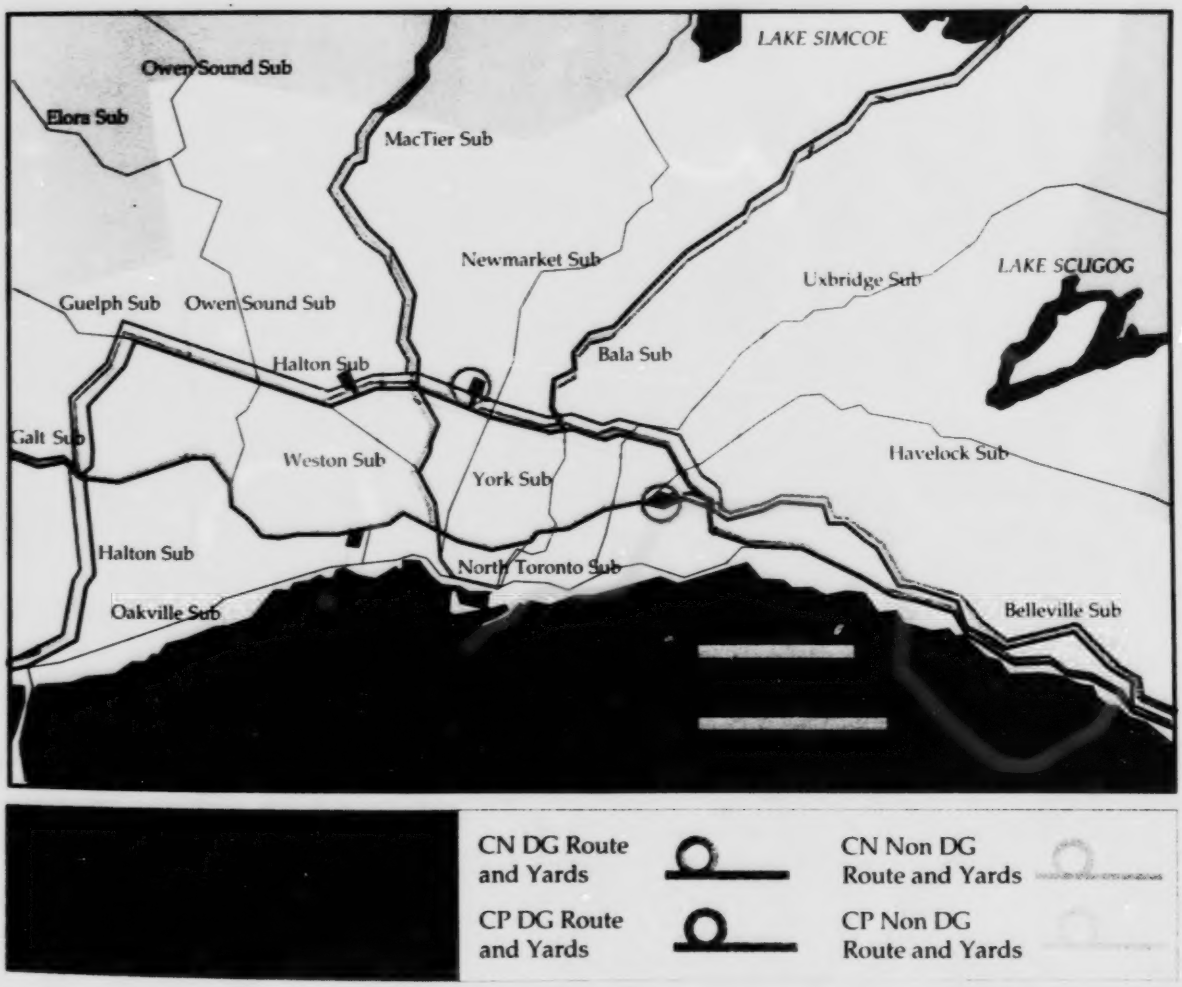
Havelock Sub
Halton Sub
North Toronto Sub
Oakville Sub
Belleville Sub
CN DG Route and Yards
CN Non DG Route and Yards
CP DG Route and Yards
CP Non DG Route and Yards

3.3 The Parkway Belt Options

These alternatives use portions of the present Parkway Belt corridor, the Canadian National's Halton and York Subdivisions and the Canadian Pacific's Galt Subdivision. We developed six sub-options for this Corridor depending on whether only dangerous goods trains would be diverted (sub-option B-1); whether all mainline freight trains would be diverted (sub-option B-2); and whether any new rail yards would be required (sub-option B-3). These three sub-options were divided further depending on whether a proposed by-pass around Thornhill and parts of Vaughan and Markham would be used.

The Parkway Belt options are illustrated in Exhibits S-4, S-5 and S-6.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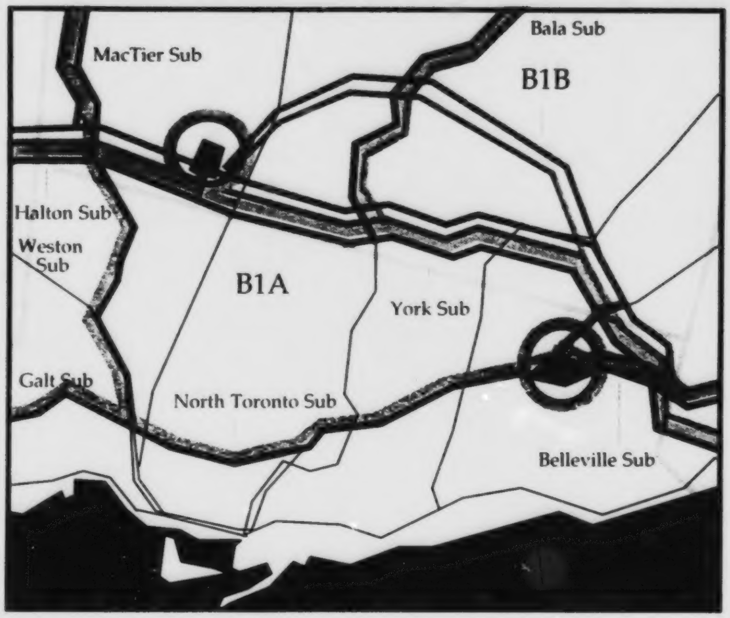
Detail showing the differences in the corridor options B1A and B1B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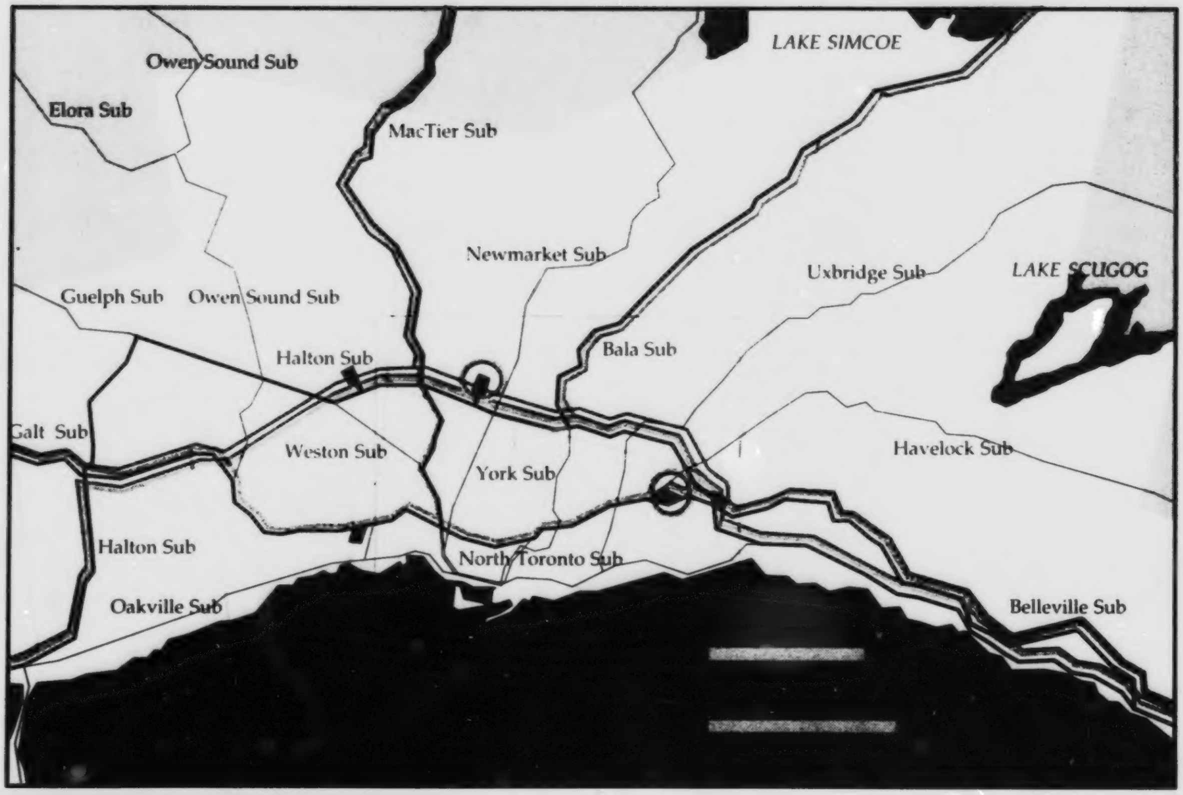
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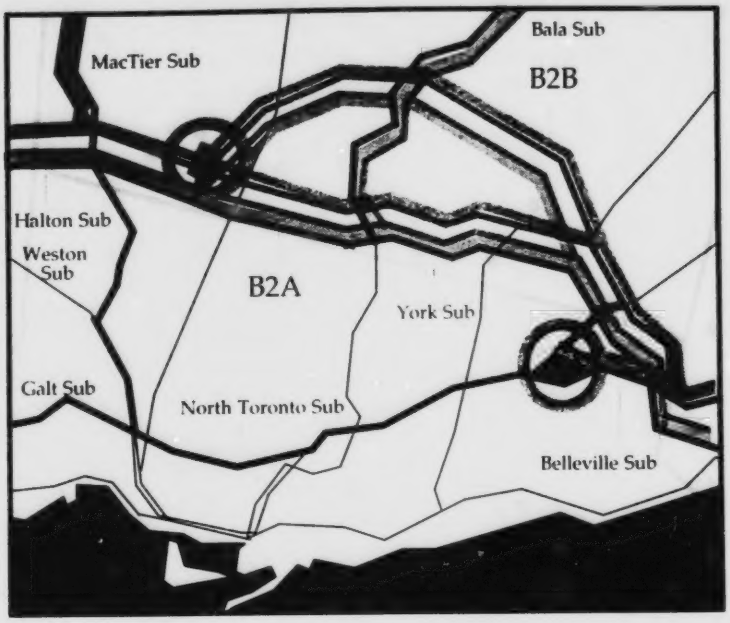
Detail showing the differences in the corridor options B2A and B2B



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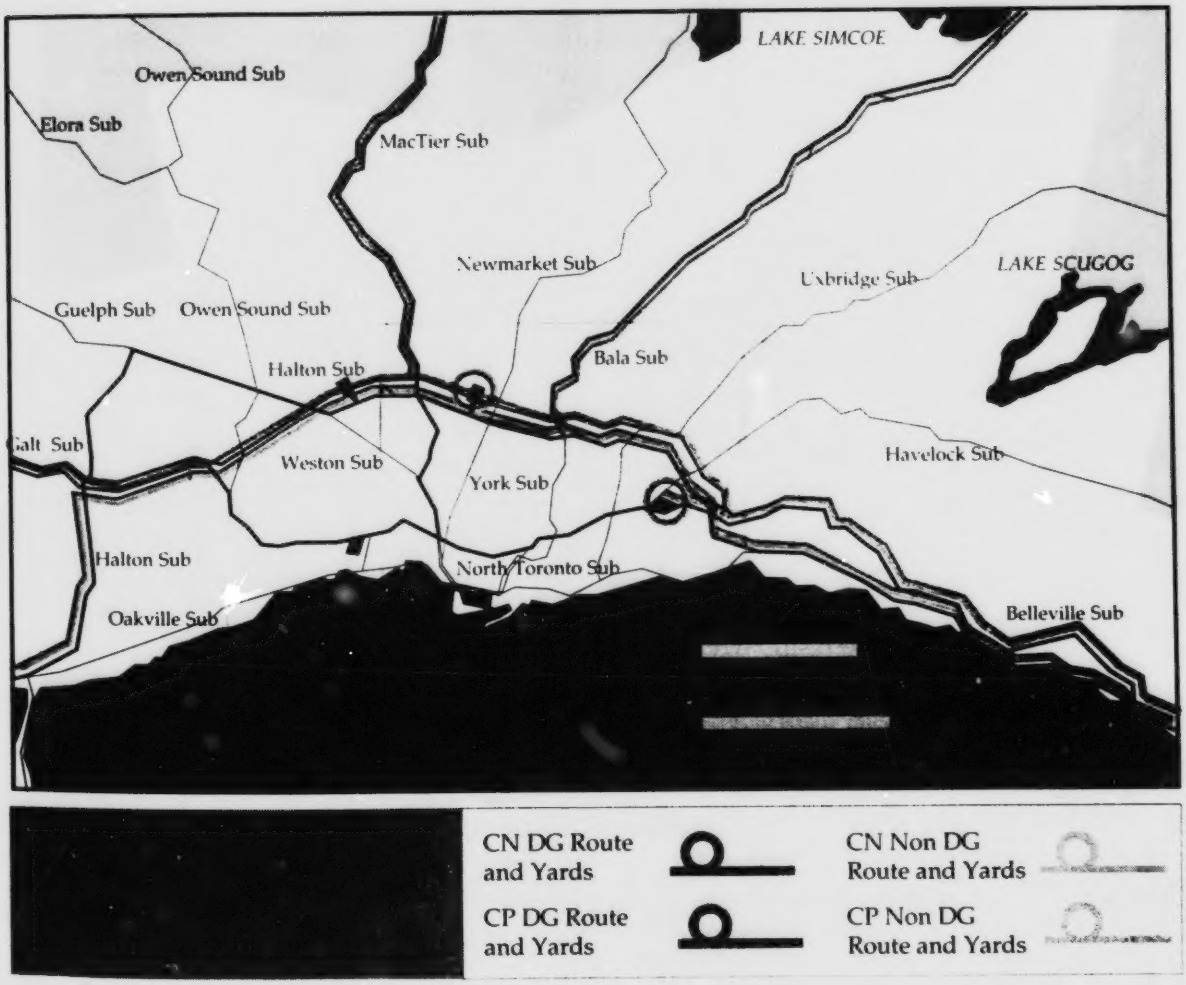

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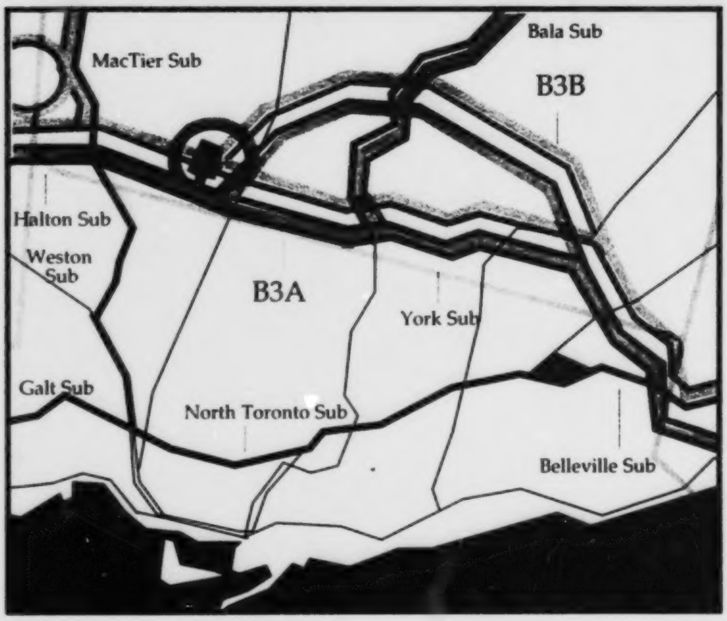
CP Non DG Route and Yards

Detail showing the differences in the corridor options B1A and B1B



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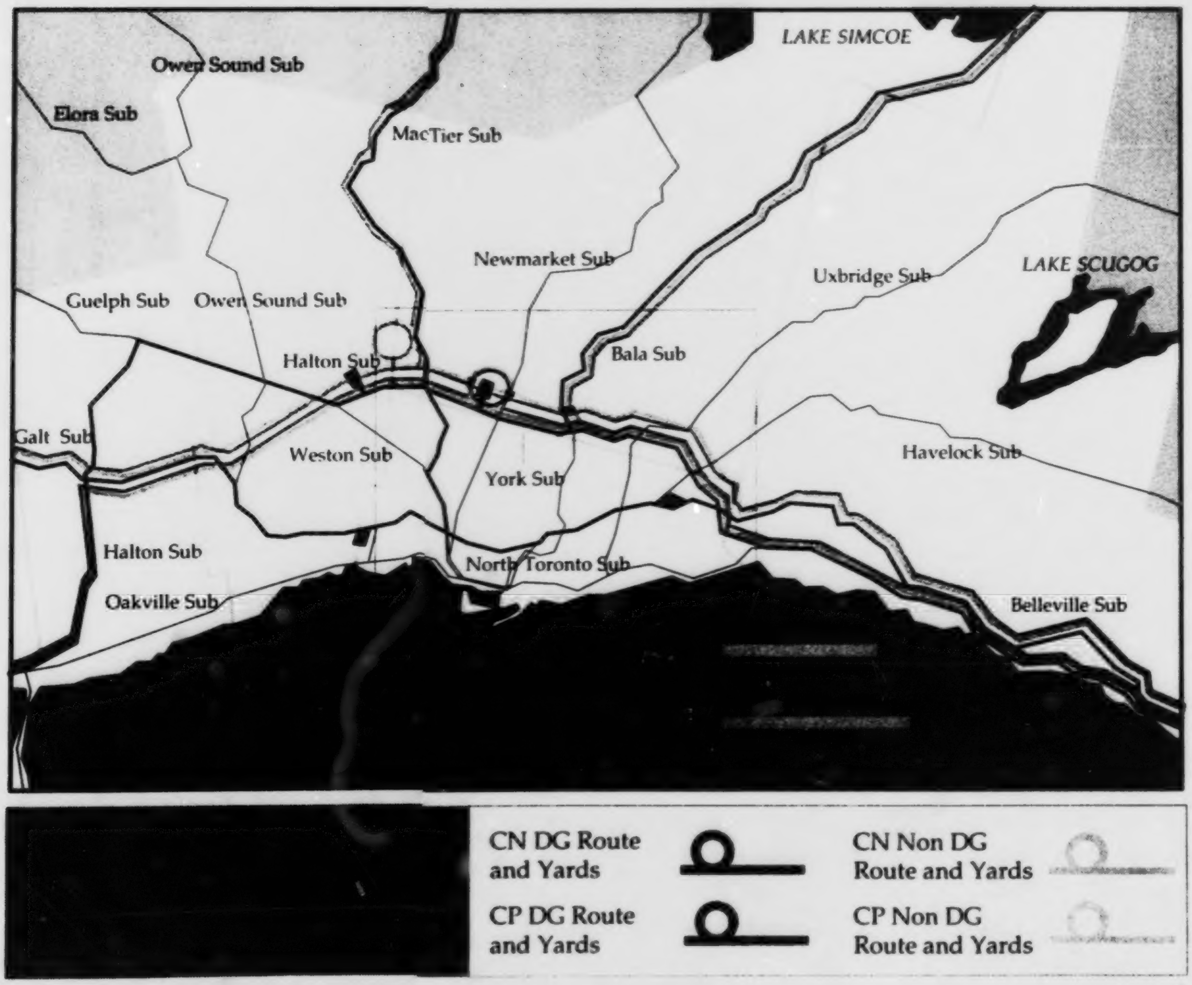

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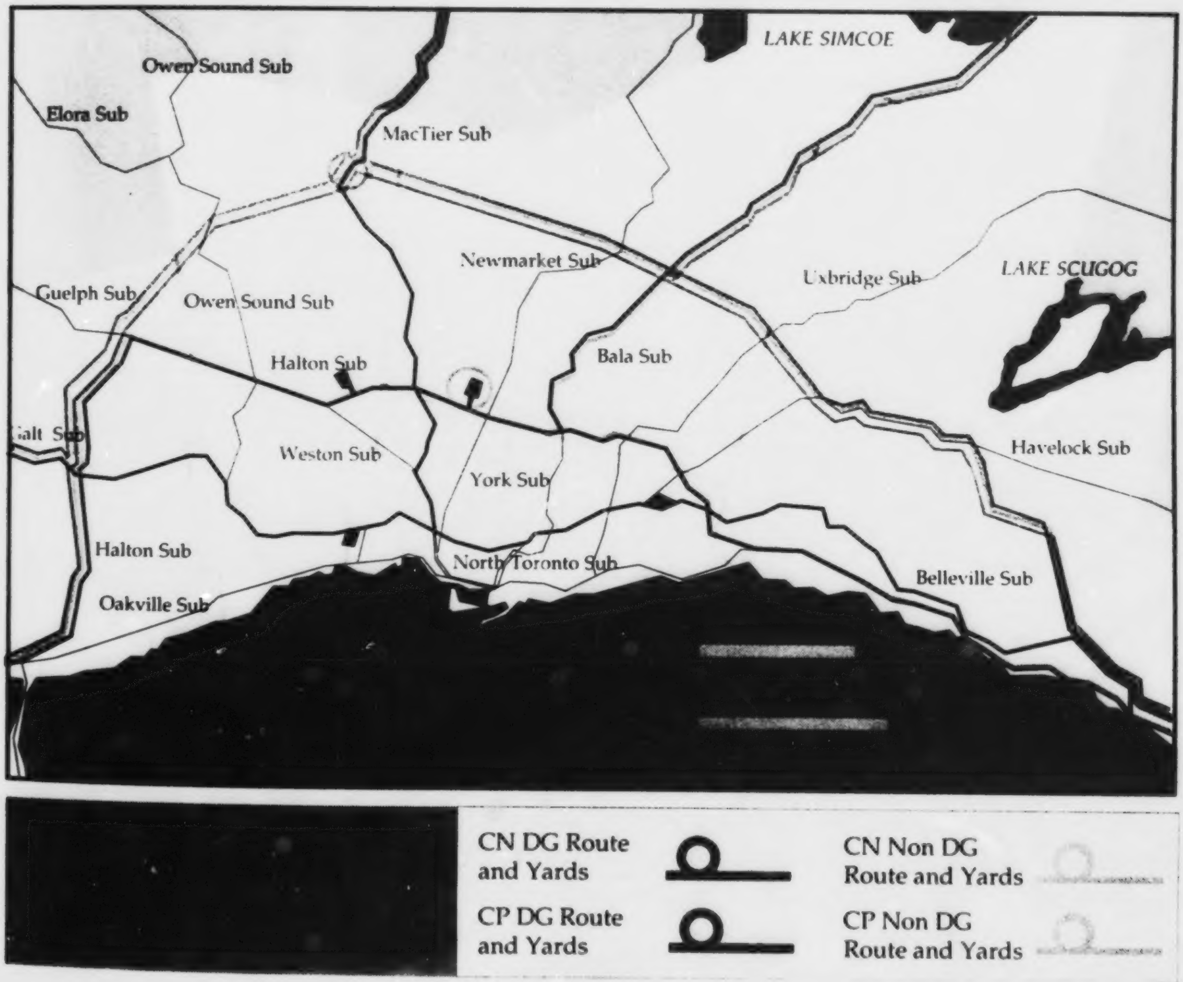
Halton Sub
North Toronto Sub
Oakville Sub
Belleville Sub
CN DG Route and Yards
CN Non DG Route and Yards
CP DG Route and Yards
CP Non DG Route and Yards

3.4 The North Corridor Options

The North Corridor would pass to the north of projected development to the year 2011. It would avoid communities and other populated areas, yet would lie south of the railway incompatible terrain north of the Georgetown, Caledon East and Oak Ridges areas . This option would use part of Canadian National's Halton Subdivision west of Toronto; would require new construction in the North of the Greater Toronto Area on an east-west arc; and finally would join up with the existing Canadian National's Kingston and the existing Canadian Pacific's Belleville Subdivisions to the East.

We studied three sub-options within the two proposed routings in this area in order to determine the maximum and minimum range of benefits and disbenefits. Alternative C-1 was the most northerly of these routings, requiring the most new trackage and rail yards. Alternative C-3 was the most southerly of the routing options studied in the North Corridor. Alternative C-2 followed the C-1 route but simulated a different traffic configuration than did Alternative C-1. These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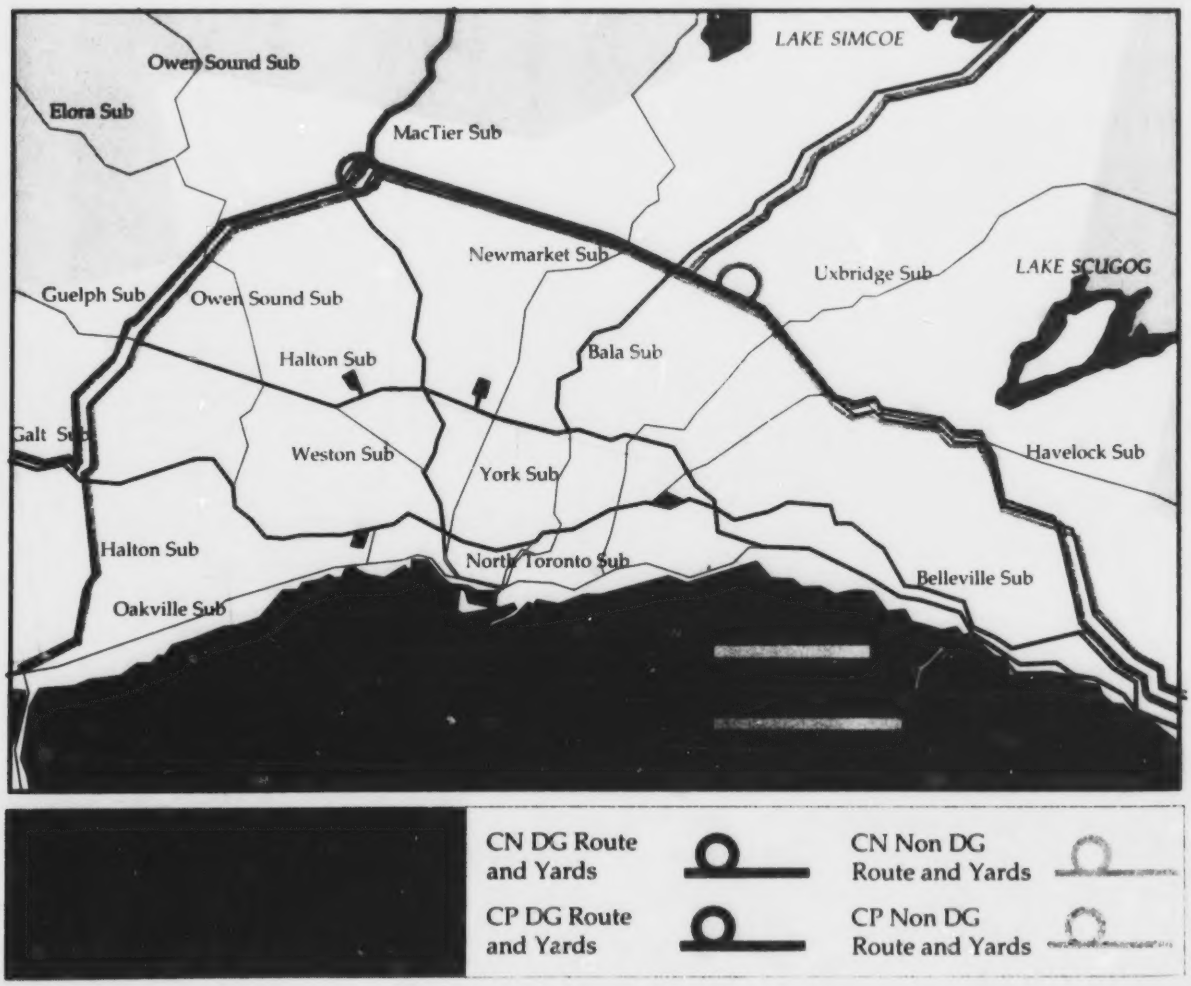
North Toronto Sub
Belleville Sub
Oakville Sub
CN DG Route and Yards
CN Non DG Route and Yards
CP DG Route and Yards
CP Non DG Route and Yards

sub-options are illustrated in Exhibits S-7, 8 and 9. Sub-options involving a bypass around the built-up areas in the Region of Durham were also studied.

3.5 Economic Impacts

We calculated both the capital and annual operating costs, relative to the existing system, for each rerouting option. These are shown in 1987 dollars and are at a level of accuracy appropriate to this type of feasibility study (i.e., +/-25%). The capital costs include the cost of land (except for buffer zones on new rail lines), new tracks and rail yards, bridges, switches and grade separations where necessary. Operating costs shown reflect only the increase or decrease that would be experienced by the railways over their present operation. We would stress that our analysis was on a relative and comparative basis for each option rather than determining the total operating costs of the railways.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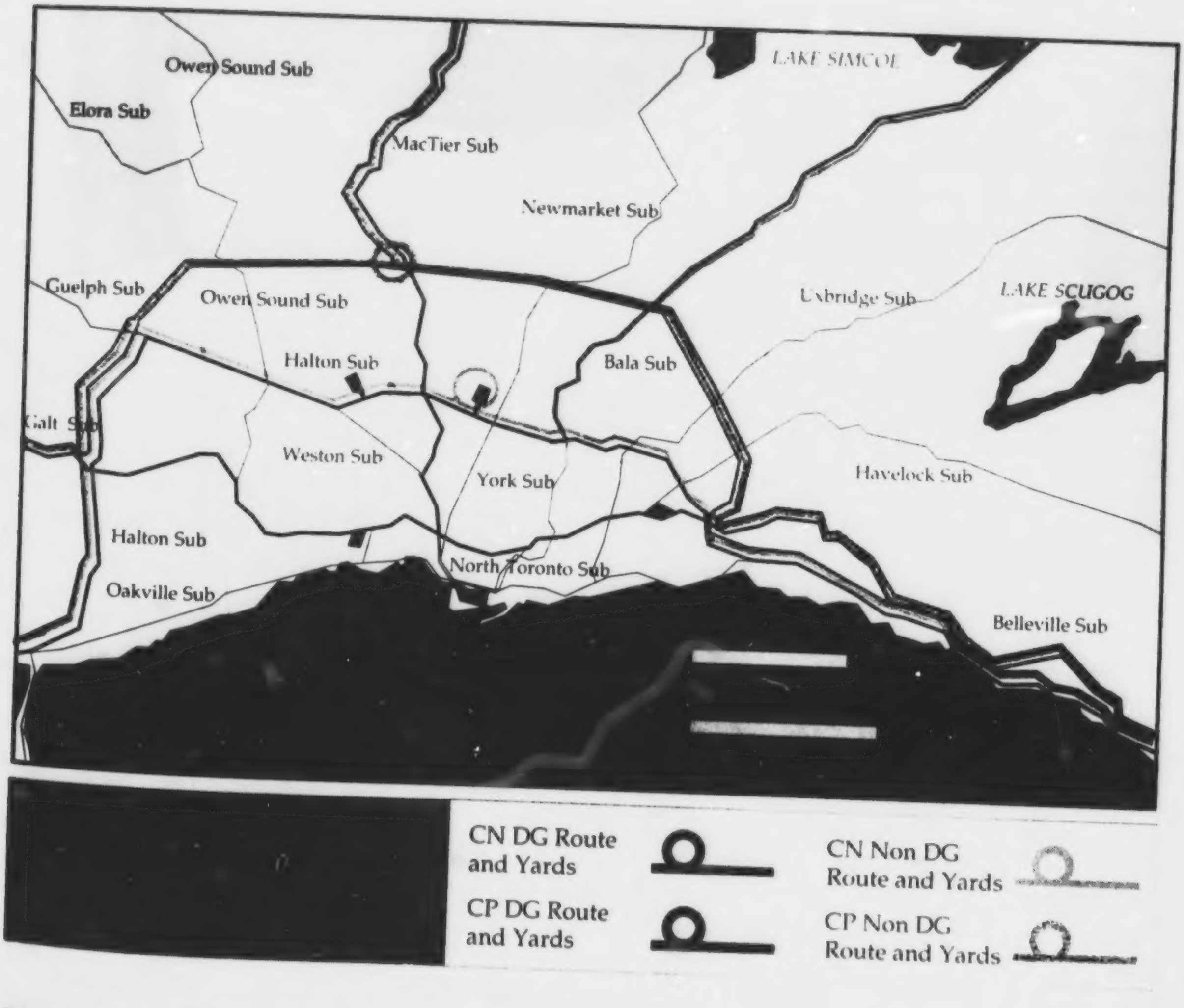
Capital costs ranged from zero (0) dollars for the existing system (Alternative A-1) to $1.686 billion for our most northerly option (Alternative C-2). Operating costs, on the other hand, ranged from an annual net saving of $1.6 million (Canadian National Railways would experience most of this saving because of shorter travelling distances) for one of the Parkway Belt options (Alternative B1A) to an annual net operating cost increase of $36 million for the most northerly North Corridor option (Alternative C-1).

3.6 Community Impacts

To determine the impact of our alternatives on communities, we measured the loss of developed or developable land, that would be required for new tracks. We also measured the 'barrier' effects our options would have between communities. To determine this impact, we used the length, in kilometers, of new rail line which might cause a visual intrusion.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The loss of developed or developable land went from zero for the existing system (Alternative A-1) to a high of 131.0 kilometers for the most northerly relocation option. On the other hand, the community 'barrier' measure indicated that the existing system and one of the Parkway Belt options had the highest barrier effects (219.3 kilometers and 219.4 kilometers respectively).

3.7 Natural Environmental Impacts

We used three measures to indicate the effects our alternatives would have on the environment. As a rough measure of noise and vibration effects, we estimated the number of persons living within one kilometer on either side of any existing or proposed rail line. We counted the number of streams our proposed rail lines would cross. And we calculated the number of kilometers of rail line that would cross environmentally sensitive areas.

For noise and vibration, the existing system, with its higher population proximity, exhibited the highest impact, with the most northerly alternatives exhibiting the least impact in this category. The existing system indicated the highest number of streams and rivers crossed. In terms of environmentally - sensitive areas however, the exact opposite was indicated, with the more northerly options crossing the Humber Valley and the Oak Ridges moraine.

3.8 Safety Impacts

In order to measure the safety benefits achieved by rerouting, we needed to quantify the risk of a dangerous goods rail accident on each alternative. Since we were primarily interested in the differences between each alternative, we used what is called the 'relative risk' approach.

We measured the probability of the most hazardous types of accidents (those involving blast waves, fires and toxic gas clouds), using seven representative dangerous goods products. These products were chosen to represent the more dangerous of the products normally carried in the Greater Toronto Area.

We selected "statistical fatalities" as the measure of risk involved. Our consultants advise that sub-lethal injuries and property damage would occur in the same proportion as fatalities, so we feel that this measure provides for a reasonable comparison between the alternatives.

The risk to the public in the Greater Toronto Area is estimated at 4.1 statistical fatalities per year for the existing rail system. This risk figure could be reduced to 2.5 statistical fatalities per year (a 40% reduction) in the Parkway Belt options, and to an estimated 1.0 (a 75% reduction) in the North Corridor options.

However, when considering risk on an absolute basis our consultants advised that the figures quoted may overstate the risk due to the assumptions and approximations made in their study. They estimated that the absolute or real risk is probably somewhere in the range of twice to one tenth the figures we used. Their professional judgement is that the real risk is probably one third of the figures quoted in our Report. The risk reduction figures are based on 1991 population figures. These risk reductions would be altered to 35% and 67% for the Parkway Belt and the North Corridor respectively if the 2011 population forecast figures were used.

Exhibit S-10 summarizes our findings by evaluation criteria, for the alternatives we studied.

Exhibit S-11 illustrates the relative risk by alternative. Exhibit S-12 shows the cost-to-risk ratio, demonstrating that different alternatives can achieve the same risk reduction, but at different costs.

In addition to examining the rail system in the Greater Toronto Area as a whole, we also examined it segment by segment. Segmental risk is a relatively complex calculation involving the types and volumes of dangerous goods traversing a certain area by rail. It also involves the meteorological, topographical and population density characteristics (daytime and night-time) of that location, and combines all these with previously-determined human vulnerability and release data.

We studied 45 different linear rail segments, each having varying lengths depending on their main line or switching characteristics; six rail yards; and the population at risk within four band widths of 250/500/1000/1000+ metres on all sides of the rail lines and yards mentioned above.

Exhibits S-13 and S-14 outline the risk by segment. (Note: These two exhibits should be used together. For example, segment 06 on Exhibit S-13 will relate to segment A1-06 on Exhibit S-14.)

Exhibit S.10
Evaluation Indices for Alternative Routes and Operating Plans

1.0 Safety Impacts
1.1 Societal Risk 1991 (average yearly fatalities)
1.2 Societal Risk 2011 (average yearly fatalities)

2.0 Community Impacts
2.1 Loss of Developed Land (km)
2.2 Loss Developable Land (km)
2.3 Loss of Farm Land (km)
2.4 Community Barrier Effects (km)

3.0 Natural Environment Impacts
3.1 Noise and Vibration Exposure (people)
3.2 Visual Impact Effects (km)
3.3 Water Quality/Aquatic Life Effects (crossings)
3.4 Spec. Vegetation/Wildlife Area Effects (km)

4.0 Economic Effects
4.1 Capital Cost ($ million)
4.2 Operating Costs (capitalized) ($ million)
4.3 Impact on Planned Commuter Service ($ million)
4.4 Buffers ($million) *Refer to section 3.12*

** Capital costs shown are net of estimated return from sale of existing rail yards.*
Operating cost/savings have been capitalized over fifty years
Numbers in brackets denote potential cost reductions rather than costs. Actual cost reductions from impacts on rail commuter service would depend on negotiations between the railways and Go Transit if improved commuter services were to be implemented.

Existing System		Parkway Belt Corridor						North Corridor		
A1	**A2**	**B1A**	**B2A**	**B3A**	**B1B**	**B2B**	**B3B**	**C1**	**C2**	**C3**
4.1	2.4	2.5	2.5	2.5	2.3	2.3	2.3	1.0	1.0	1.1
4.6	3.3	3.0	3.0	3.0	2.9	2.9	2.9	1.5	1.5	1.7
0.0	0.0	12.5	12.5	12.5	16.0	16.0	16.0	6.5	6.5	1.5
0.0	0.0	1.5	1.5	1.5	6.5	6.5	6.5	3.0	3.0	5.5
0.0	0.0	14.0	14.0	14.0	24.0	24.0	24.0	121.5	121.5	89.0
219.3	219.3	219.4	146.5	146.5	194.7	122.3	122.3	119.8	41.3	92.5
1,199	1,999	1,112	530	530	1,067	484	484	499	79	584
0.0	0.0	4.0	4.0	4.0	7.0	7.0	7.0	52.0	52.0	24.0
369	320	331	331	331	344	344	344	285	285	299
19.5	19.5	16.5	12.0	12.0	16.5	12.0	12.0	89.0	57.0	14.0
0	54	372	615	758*	612	823	966*	1,000*	1,581*	725*
0	142	(29)	115	(7)	(29)	115	(7)	657	484	325
0	0	(55)	(130)	(130)	(72)	(147)	(147)	(108)	(162)	(107)
								300	to	500

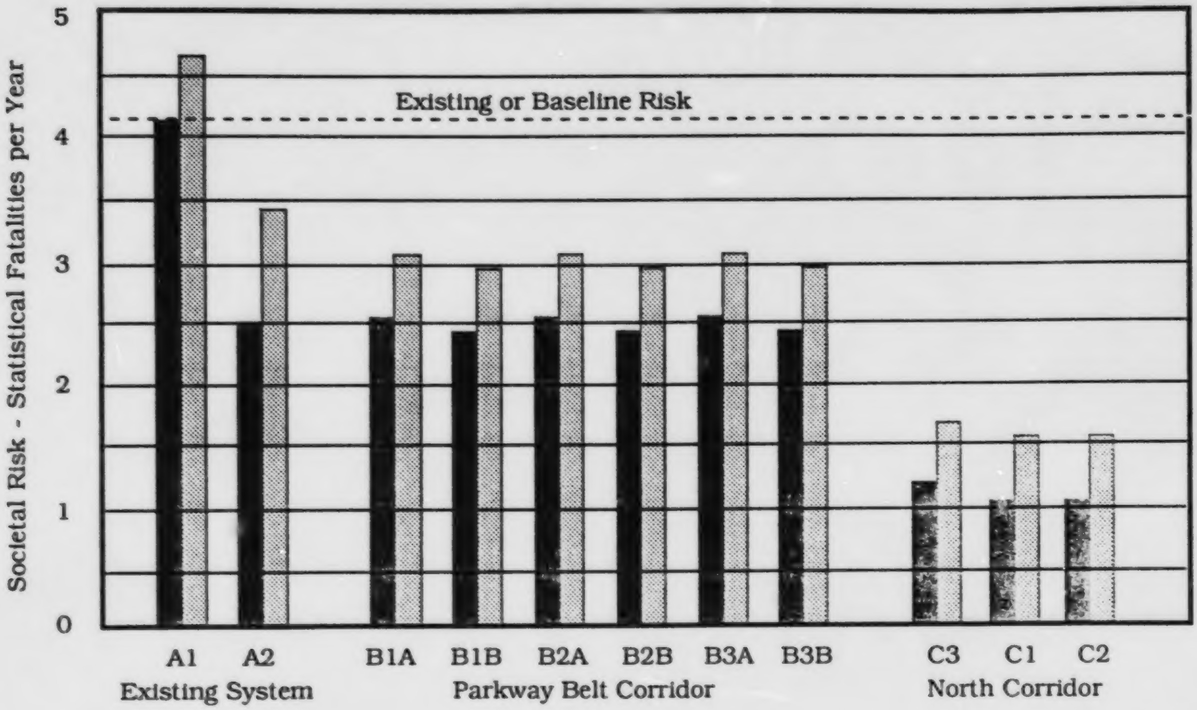


Exhibit S.11
Comparison of
Societal Risks for
Rail System Alternatives

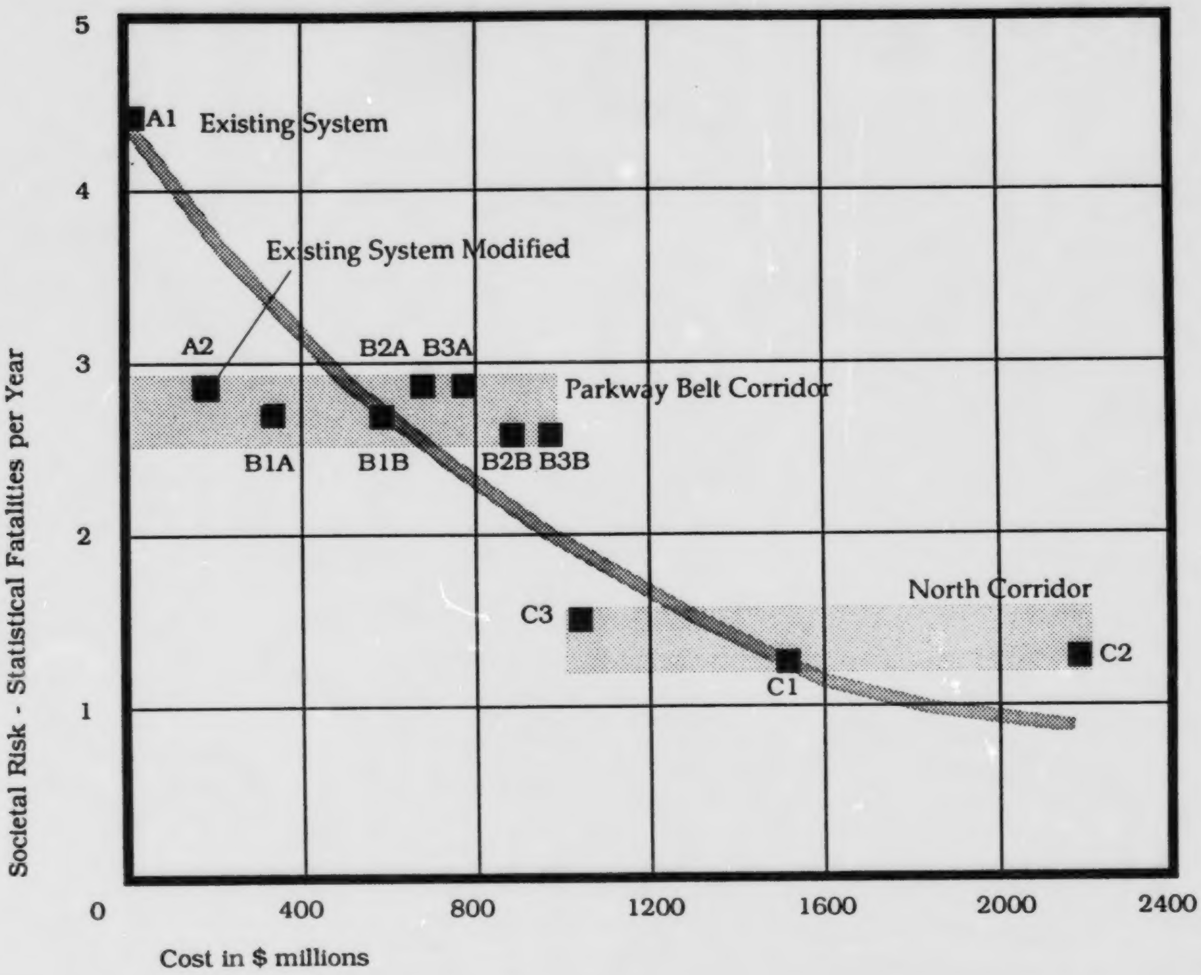
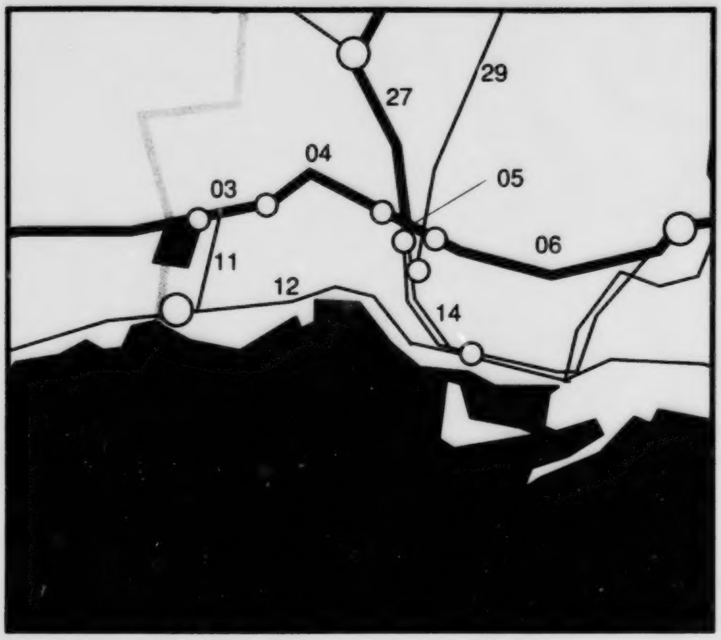


Exhibit S.12
Risk vs Cost

▨ Risk Similarities

▨ General Risk Cost Curve (risk values have been averaged between 1991 through 2011)

Segment detail of downtown Toronto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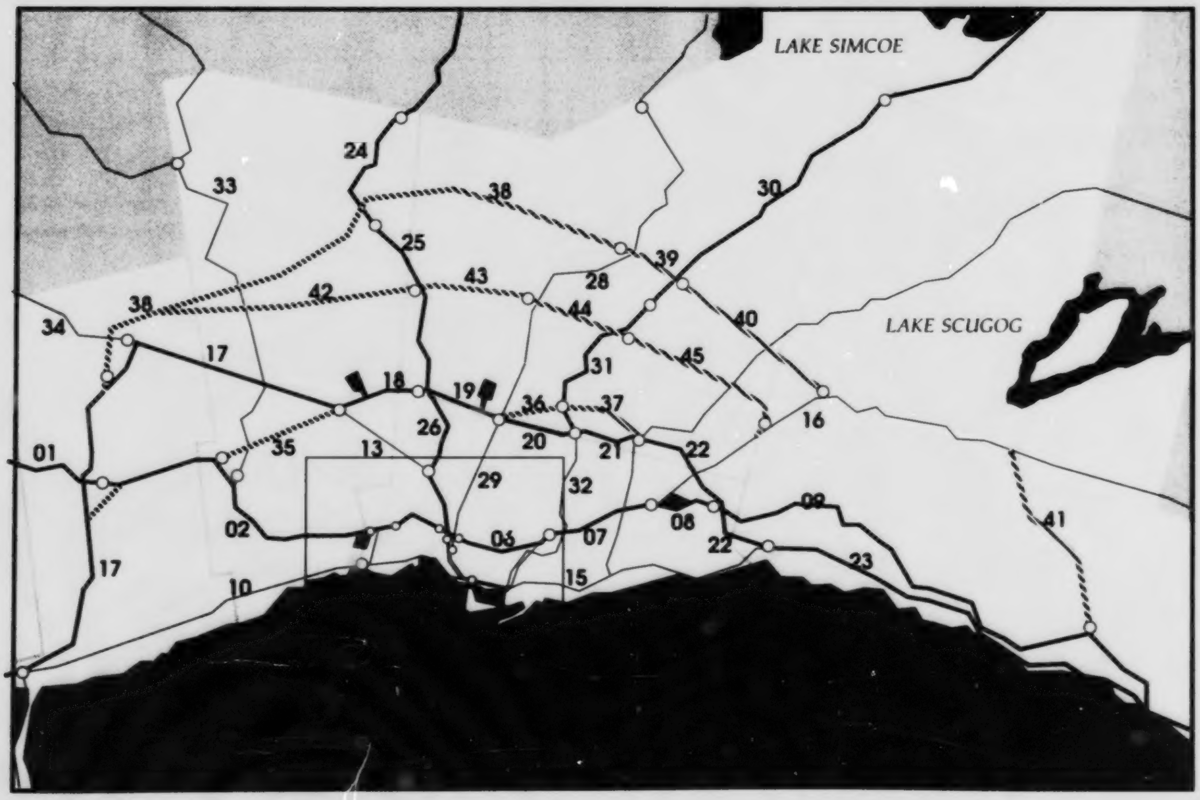
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Exhibit S.13
Rail System Segments

Some segment lengths vary between alternatives due to operational differences.
Segments relate to system alternatives shown on Exhibits S.14

Exhibit S.14
System Risk By Segment Alternative A1 for 1991

Segment	Subdivision	Length (km)	Societal Risk For Segment (Fatalities/Per Year)	Societal Risk Rate Along Segment (Fatalities/Year-km)
A1-01	CP Galt	15.6	0.0464	0.0030
A1-02	CP Galt	34.5	0.1707	0.0049
A1-03	CP Galt	2.4	0.0300	0.0125
A1-04	CP Galt	3.9	0.0675	0.0173
A1-05	CP Galt/N.Toronto	3.0	0.2341	0.0780
A1-06	CP N.Toronto	9.1	0.3642	0.0400
A1-07	CP Belleville	12.5	0.1793	0.0143
A1-08	CP Belleville	4.6	0.0259	0.0056
A1-09	CP Belleville	64.3	0.1026	0.0016
A1-10	CN Oakville	38.0	0.1180	0.0031
A1-11	CP Canpa	4.2	0.0110	0.0026
A1-12	CN Oakville	13.4	0.0201	0.0015
A1-13	CN Weston	9.4	0.0004	0.000043
A1-14	CN Weston	5.7	0.0282	0.0049
A1-15	CN Kingston	32.6	0.0055	0.00017
A1-16	CP Havelock	42.8	0.0007	0.000017
A1-17	CN Halton	65.6	0.3848	0.0059
A1-18	CN Halton	7.6	0.0646	0.0085
A1-19	CN Halton/York	9.0	0.0208	0.0023
A1-20	CN York	7.3	0.1947	0.0267
A1-21	CN York	8.0	0.0435	0.0054
A1-22	CN York	23.4	0.0050	0.00021
A1-23	CN Kingston	52.5	0.1061	0.0020
A1-24	CP MacTier	16.4	0.0060	0.00036
A1-25	CP MacTier	17.8	0.0095	0.00053
A1-26	CP MacTier	9.2	0.0179	0.0020
A1-27	CP MacTier/CN Weston	7.1	0.1448	0.0204
A1-28	CN Newmarket	44.6	0.0131	0.00029
A1-29	CN Newmarket	14.2	0.0589	0.0041
A1-30	CN Bala	21.3	0.0141	0.00066
A1-31	CN Bala	62.0	0.0462	0.00075
A1-32	CN Bala	22.9	0.0589	0.0026
A1-33	CP Owen Sound	57.9	0.0001	0.000003
A1-34	CN Guelph	13.5	0.0005	0.000037
	Yards			
A1-Y1	CN MacMillan		0.6776	
A1-Y2	CN Mimico		0.0015	
A1-Y3	CN Don		0.0059	
A1-Y4	CP Agincourt		0.0931	
A1-Y5	CP Lambton		0.6068	
A1-Y6	CP Obico		0.0045	
A1-Y7	CP Ray Ave		0.0917	

Total Societal Risk for Toronto Area Rail System
= Sum of Societal Risks for all Segments = 4.1 Fatalities/Year

From this evaluation, we identified four areas of higher risk when compared to the other segments in the entire system. These were:

High Risk Segments

Segment No.	Description	Societal Risk Rate (Fatalities/yr./Km.)
a) A1-05	The Canadian Pacific Galt/ North Toronto Segment (3 kilometres)	.0780
b) A1-06	The Canadian Pacific North Toronto Segment (9.1 kilometres)	.0400
c) A1-20	The Canadian National York Segment (7.3 kilometres)	.0267
d) A1-27	The Canadian National MacTier/Weston Segment (7.1 kilometres)	.0204

(While Segments A1-20 and A1-27 are included in the above listing, they are considerably lower in risk than Segment A1-05.)

We have concluded that there is an uneven distribution of risk within the total rail system with the highest risk segment (.078 estimated fatalities/km/year) having 26000 times more risk than the segment with the least risk (.000003 estimated fatalities /km/year). This is due to increased population densities, land use, vehicular traffic densities, congestion, and street systems. All these are occurring in the same locations as increased rail congestion, which requires a larger number of switches and handling operations.

At this point we wish to record the minority position of two Task Force members. They feel that the relative risk figures of 4.1, 2.5 and 1.0 statistical fatalities used for the Existing System, Parkway Belt and North Corridor alternatives may be viewed too literally. Since, as stated above, our consultants have indicated that the absolute risk lies somewhere between twice to one tenth of the figures we have used (but are probably about one third of our figures), and given the relative newness of this science, the minority Task Force members wish to emphasize that the risk figures should be viewed more as a range, with the real risk lying at about 1.4, .08 and .03 respectively for the above alternatives.

This minority position further wishes to stress that the line above which high risk is determined should also be viewed with some latitude. Our consultants have shown that risk of one statistical fatality in every 10 to 100 years equates to a societal risk rate of .020 and above - thereby identifying two Canadian Pacific and two Canadian National rail segments as 'high risk'. However, if the high risk rate had been set at .040 and above, only the Canadian Pacific North Toronto Subdivision segments would have been identified as high risk. It is their opinion therefore that care should be taken in selecting this high risk identifier, since it could have applications outside the Greater Toronto Area.

Since, however, the figures of 4.1, 2.5 and 1.0 have been substantiated and documented by our consultants; since any other figure is at best a professional judgement; and since we are, as stated on several occasions, undertaking a feasibility study of relative comparisons, we have continued to use the above figures throughout our Report.

3.9 Conclusions on Rerouting

We have concluded that the existing system is generally safe. However, as we discuss in a later chapter, improvements can be made which would make the system even safer. While none of these improvements taken alone would provide a "giant step forward" in rail safety, taken together they would provide greater safety to the public in the Greater Toronto Area.

With respect to rerouting and relocating the existing system, we concluded that such an undertaking is feasible from an engineering and operational point of view. This rerouting would reduce the risk over the entire system, and more importantly in the 'high risk segments' identified above. However, we have concluded that this risk reduction alone is not sufficient justification for us to recommend that rerouting or relocation be undertaken. (One member of our Task Force quite strongly believes that risk reduction alone is sufficient justification for this undertaking.)

We believe rerouting should be considered within the context of a totally integrated and rationalized rail system for Greater Toronto. While this was not within our mandate, we do feel that there could be economic benefits for the railways, shippers and the public at large from the rationalization of at least part of the rail system. Furthermore, and of course this was clearly within our mandate, we believe that such a rationalization of the system could provide the opportunity to improve safety by reducing risk, especially in the high risk segments of the system. When both economic and safety benefits are considered, there may be sufficient justification for this large undertaking.

If rerouting and relocation does take place, we believe it could, as a first alternative, follow the Parkway Belt Options. The Parkway Belt offers the greatest opportunities for reduced track mileage, increased track capacity, and effective buffering zones along the rail corridor.

A 'Joint Use Agency' may be an appropriate mechanism not only to implement rail rationalization, but to carry out the operational administrative needs as well, in order to assure fairness for both railways.

We recommend immediate action to establish a Rail Rationalization Strategy Team made up of representatives from the Federal Government, the railways and the Province of Ontario, to determine the costs, benefits and administrative mechanisms of a rationalized network for at least part of the system in the Greater Toronto Area.

If the Parkway Belt is found to be inappropriate, we recommend that this Team consider the North Corridor - particularly the more southerly of the sub-options, Alternative C3 - as a viable alternative. We acknowledge that the land would have to be zoned by the Province or acquired by the railways and the Federal Government. This would be a tremendous task. However, if a second corridor is needed to handle growth into the 21st Century, action is needed now to avoid the problems of encroachment that have occurred in the past.

This has lead us to the question of how Governments can prevent this encroachment from happening in the future. We deal with this question under the heading of 'Buffers'.

3.10 Buffers

Urban developments have been continually encroaching up to existing rail lines for many years, and this encroachment is not reversible. However, buffering is still possible in areas not yet developed along existing and future rights-of-way.

By a 'buffer', we mean more than a berm, ditch or wall; these are not effective protection in the event of a dangerous goods accident. A buffer is a strip of land separating rail lines from sensitive developments. This strip of land need not be sterile; development can be allowed, provided it is compatible with the rail lines.

Establishing compatible-use buffer zones and guidelines on the redevelopment of lands adjacent to railways should be a priority, requiring the full cooperation of all levels of government. Leadership needs to be given in this area by the senior levels of government.

3.11 Paying the Costs

The federal government, the Province of Ontario, Municipalities, the railways, and the general public would all benefit from our proposals. However, the primary responsibility lies with the federal government, since the railways fall under federal jurisdiction.

The railways, like any corporation, must bear the normal costs of operating safely and responsibly within their competitive environment. But if society demands standards of safety above a reasonable limit, society should pay. The costs of rerouting and of providing buffering, for a system that is already reasonably safe, is therefore in our view a federal responsibility.

The Province of Ontario and Municipalities are responsible for planning and administering land use. It is their responsibility to ensure that rerouting and buffering proceeds smoothly and that, with their cooperation, public safety is enhanced.

3.12 Recommendations

The Analysis of Routing Alternatives

Our recommendations concerning rerouting are:

Abandonment and Sale of Specific Railway Infrastructure

- No consideration be given at this time to abandoning the present Canadian Pacific Railway's North Toronto Subdivision.
- Should rerouting or relocation take place, this right-of-way continue to be used for all 'local' traffic and for 'through' non-dangerous goods freight traffic.
- Should excess rail capacities become available on this or any other rail line in the Greater Toronto Area, consideration be first given to their use as possible public transportation corridors.

Railway Rationalization (Involving the Parkway Belt)

- A team, consisting of representatives from the Minister of Transport, the Province of Ontario and the two major railways, be immediately established to:
  - ☐ Prepare a plan for the rationalization of the rail systems

through the affected area;

☐ Quantify the economic advantages for such a system;

☐ Provide the detailed capacity and operational requirements;

☐ Advise on a type of Joint Use Agency equitable to all parties and suitable for the management of operations in this Joint Use territory; and to

☐ Provide a detailed implementation strategy.

- Contingent on rail rationalization, the Parkway Belt Corridor options be considered as providing the best rerouting and relocation opportunity in the Greater Toronto Area.
- The specific Parkway Belt option, which diverts dangerous goods into the Belt (thus providing buffering as an increase to public safety for present development), while utilizing the present Canadian National Railways' York Subdivision for general, non-dangerous freight traffic be considered most advantageous.
- The Province of Ontario be requested to retain provision for a mainline rail facility in the Parkway Belt in conjunction with its development, planning and constructiuon of other facilities.
- In conjunction with the Municipalities, the Rail Rationalization Team be asked to identify, as quickly as possible, those areas along the existing and Parkway Belt segments where additional buffers can be provided through zoning, compatible with rail operations.
- The Province of Ontario, in conjunction with the Municipalities, be requested to zone those lands, identified above, accordingly.
- The Rail Rationalization Team should also give consideration to the joint use of Canadian National's Kingston Subdivision for the rail movement of dangerous goods in the Regional Municipality of Durham.

The North Corridor Options (The 'C' Alternatives)

- As a matter of urgency, the Minister of Transport, along with the Province of Ontario and the railways, undertake a review of the necessary preliminary actions required for determining and developing a transportation/utility corridor in the north of the Greater Toronto Area.
- In reviewing the North Corridor, the more southerly North Corridor option (Alternative C-3) be considered the preferred option.

Buffers

- The federal government assume the responsibility for establishing buffer zone criteria and that this determination should be done with as much input from the Province of Ontario, the Municipalities, industry and the railways as possible.

- The federal, provincial and municipal authorities work cooperatively, in their respective spheres, to introduce, or make provision for buffers along new rail lines and rail yards in non-developed areas.
- Buffer zones be so established as to allow railway-compatible infrastructure and activity, and that such zones be considered for other transportation and utility corridor uses at the same time.
- As redevelopment occurs along existing rail corridors, the Municipalities ensure that compatible land uses are put into place.
- As a matter of priority, the federal and provincial governments initiate discussions immediately on how, in the Greater Toronto Area, buffers could apply to the Parkway Belt and North Corridor options and from these discussions develop policy that could be applied here and elsewhere.

Costs and Who Pays

- The federal government bear the net cost of any railway rerouting/relocation (after allowing for the benefits that can be achieved with respect to identified railway operating cost reductions; the sale of surplus railway lands; and any identified benefits from a rail service rationalization).
- The federal government be responsible for all costs of buffer zone acquisition and for all injurious costs arising from 'compatible use' zoning.
- The provincial government and municipalities be responsible for all planning, zoning implementation and administrative activities in this regard.

4.0 Improving the Existing System

A Shorter Term Option

4.0 Improving the Existing System:

Even if a decision is made to reroute or relocate dangerous goods rail traffic, the decision would require a long lead time to be implemented. In the short term, every opportunity must be taken to improve the safe operation of the existing system. There are, in fact, many opportunities for improvements. These are discussed below.

4.1 Operational Management Improvements

A Classification System is needed for the Canadian railway system, with rail lines carrying dangerous goods in densely populated areas having the highest classification at each level. We have called this latter classification the 'DG level'. Incorporated into this 'DG' system would be such matters as higher maintenance standards, and more frequent maintenance inspections. This Classification System should be made known to the public, so that they can have a standard to judge the safety of the rail system running through their community.

The railways presently undertake extensive engineering and design when making repairs, implementing new technology, and carrying out maintenance. We believe however that the use of System Safety Analysis may prove beneficial in enhancing safety on the entire system. System Safety Analysis is a recognized professional technique based on a disciplined analytical approach to safety. We believe that if the public knew that such a technique was being utilized, this would contribute significantly to the public's confidence in the existing rail system. This approach, presently used in the rapid transit rail commuter industry, should be assessed for its merits and its contribution to public safety.

From the information provided by our consultants and by the railway representatives on the Task Force, we concluded that wayside detection devices should be more closely spaced in densely populated urban areas.

4.2 Technology Improvements

Although more detailed Technology Improvements are contained in our full Report, we would like to outline four major areas for improvement here.

Advance Train Control System

The Advance Train Control System employs modern, sophisticated communications, computer systems and hardware to bring operating information directly into the train's cab. This system, depending on which level of sophistication is used, can monitor the operation of a train and can bring it to a safe stop in the event of human failure.

With this system, accident frequencies caused by speeds exceeding track design would be reduced by 75%; and collisions/derailments caused by failure to comply with signals would be reduced by up to 50%. We fully endorse this technology and suggest that the Greater Toronto Area be one of the first locations for its implementation.

Concrete Ties and Direct Fixation Fasteners

Concrete ties provide a heavier and firmer support to hold track in place. Although research is being undertaken to improve hardwood ties, concrete ties have been proven to be superior in this function. By using concrete ties, accident frequencies due to gauge, track alignment, super-elevation and cross-level defects could be reduced by up to 65%, 50%, 12% and 12% respectively. (It should be noted that concrete ties do have a tendency to accentuate noise and vibration within the community.)

Automated Half Barriers and Grade Separations

Sixty percent of all train fatalities are caused at grade level crossings. On rail lines carrying dangerous goods (recognizing that some dangerous products can significantly affect the population over a large area), all steps should be taken to improve safety. We therefore suggest that the criteria for determining whether half barriers or grade separations be installed should reflect the risk from dangerous goods to the public and that the federal government should reinstate financial support for a meaningful grade separation program.

4.3 Tank Car and Train Operation Improvements

Our examination of how pressurized tank cars are manufactured, maintained, modified and repaired in North America has convinced us that these cars are among the best in the world. We are impressed with the increasing ability of tank cars to withstand severe impacts during accidents before releasing their product.

We are, however, concerned with the quality of repairs made in repair shops not specializing in tank car manufacture, and the perception that different repair levels are being achieved depending on the repair shop used. We also believe there are opportunities for further Research and Development to improve tank cars.

We examined the concept of the indestructible container and believe that, while such is achievable, it would be impractical. More cars would be needed to carry the same volume of product currently transported. This would therefore mean more loading, unloading and handling operations, increasing the risk potential at each stage.

We learned that putting heavier cars in the front of a train reduced the severity of accidents in terms of the number of cars derailing, whereas the longer the train, the more severe the accident in terms of cars derailing. More research and development into marshalling requirements should be undertaken in these areas by the Regulator.

With regard to Residue Cars, the risk potential of these cars is in proportion to the load being carried. In other words, a Residue Car has the potential for contributing up to 2% of the total risk. All but one of the Task Force believe that present rules governing these cars are satisfactory; that the present definition (i.e., 2%) categorizing these Residue Cars is appropriate; and that no more stringent operating requirements are needed for Residue Cars.

4.4 Human Factor Improvements

Technological gains in recent years have highlighted the role of human error in causing train accidents. The expertise and the physical/psychological condition of railway personnel operating trains carrying dangerous goods is therefore an obvious safety matter.

We were very concerned about the use and effect of drugs and alcohol by and on those working in safety related positions. We recommend pre-employment screen tests for both new employees, and existing employees seeking reclassification to safety related positions. Testing for 'reasonable cause' should be carried out, and Employee Assistance Programs should be vigorously promoted. We also recommend that medical checks continue to be given to railway operating personnel and that included in these medical checks there be a test for drug/alcohol abuse.

We were surprised at the virtual absence, until very recently, of Human Factor Research and Development to improve human performance within the rail system. The human will always be an important element in the transportation system and given the evidence that the human has now become a major cause of accidents, research into this area should be given priority. Such research could do much to reduce accident frequencies and enhance public safety.

4.5 Speed

We examined speed in relation to both the frequency of accidents and the severity of accidents. There is insufficient technical evidence to allow us to recommend any changes to the regulations now in effect governing speed.

However, from our public consultations as well as from the many written submissions we received, there is no question that many Municipalities and public interest groups equate lower speeds with a safer environment.

Accidents are caused more by track defects and operational handling than by speed. Train speed has a fairly direct effect on the severity of an accident in terms of the number of cars derailing, but a less direct relationship in terms of the number of cars releasing their product (See Exhibit S-15). It is the latter case that represents the risk to the public.

We recommend that further study on the causes of accidents be carried out, with priority given to the real causes of accidents such as track defects, equipment deficiencies and operational mishandlings.

While, as stated above, we as a Task Force cannot recommend any changes to the present regulations governing speeds based on the evidence we heard, we do wish to record that three members of the Task Force were most impressed with the deep public concern regarding speeds and are of the opinion that public confidence in the safety of the rail system might be improved through reduced train speeds. One member of the Task Force is of the further opinion that these reduced train speeds should be implemented through a mandatory slow order.

4.6 Research and Development

Research and development efforts are uncoordinated, thus the Regulator is unable to determine the value of the safety aspects of the research.

We firmly believe that it is only through safety research and development that significant advances will be made in public safety. We are disturbed by the under-utilization of research laboratories and testing equipment, and the trend towards

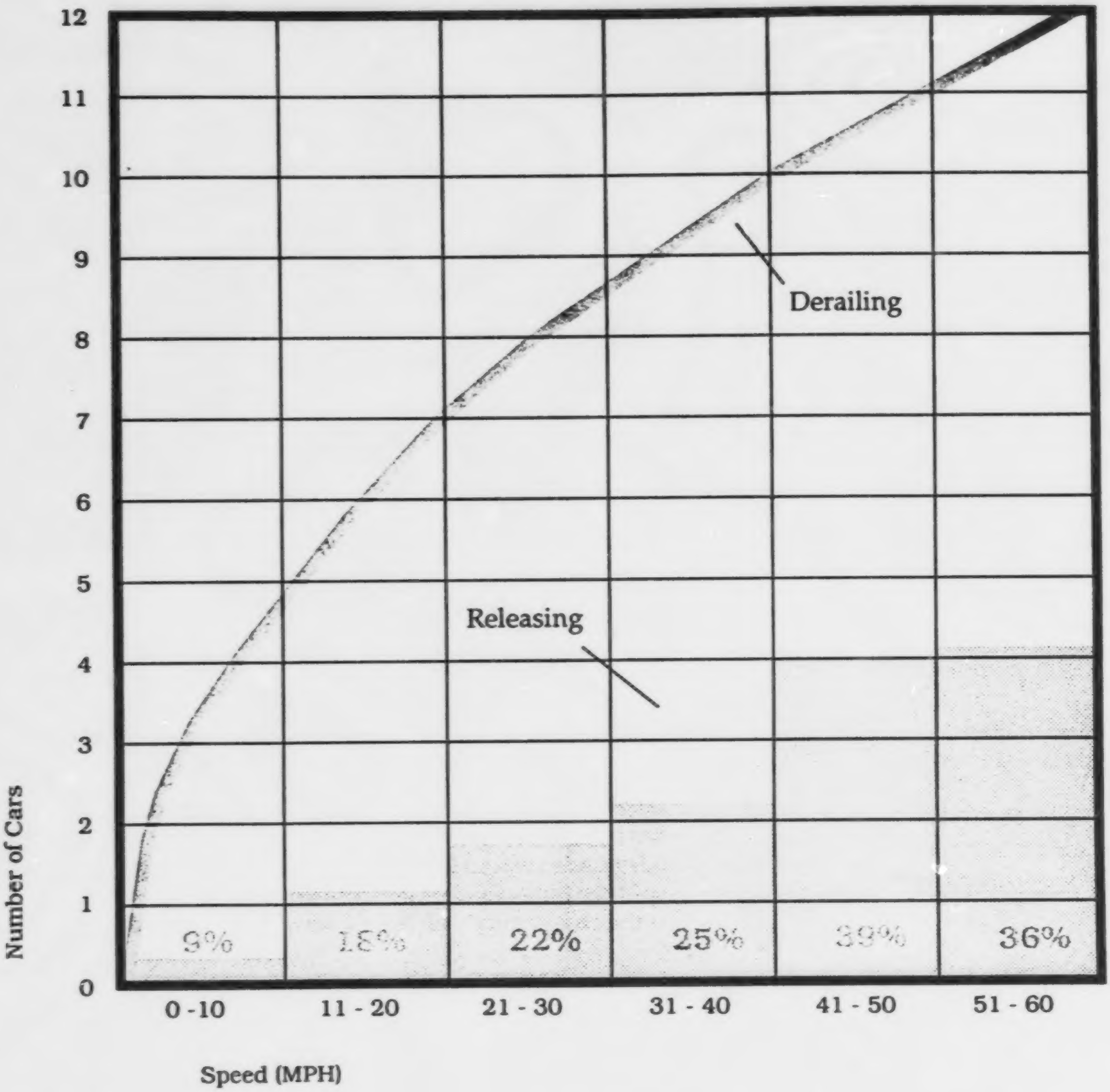

Exhibit S.15
Number of Cars Derailing compared to Percentage of Cars Releasing Product, by Speed in Mainline Accidents

▬ Number of cars damaged or derailing per accident

▨ 00% Number / percentage of cars releasing hazardous materials

less and less safety research being performed.
We recommend that the Minister of Transport undertake to co-ordinate the rail safety research program in Canada; that this co-ordination be extended to encompass the North American rail system; and that emphasis be placed on Human Factor research. In our full Report, we outline a number of other areas (such as Advanced Train Control Systems; train speed; train marshalling; and roller bearing failure) as candidates for priority research and development projects.

4.7 Emergency Preparedness & Response

No matter how safe the system, a dangerous goods accident will always be possible; communities should be prepared to deal with such an accident.

Present Municipal Emergency Response Plans are uncoordinated and, in many cases, inadequate or non-existent. In smaller communities especially, there is a lack of awareness of the risk from the dangerous goods; and a lack of training, resources, equipment and personnel. Residential development is taking place right along rail lines, making access to these lines difficult if not impossible. In some localities, evacuation would be a complex and time-consuming exercise at best.

The railways and the chemical/petroleum industries have taken their emergency responsibilities seriously, and they have professional and capable expertise to deal with dangerous goods spills. However, the effects of a dangerous goods spill can impact a large geographic area. In these situations, it is the community's resources which are required.

We suggest that the railways work in conjunction with Municipalities to develop common procedures and that, in the case of a dangerous goods accident, only one spokesperson be appointed to provide accurate and timely information to the public. The single spokesperson is one of the most effective ways of reassuring the public during an emergency and of avoiding undue anxiety.

We urge that steps be taken to upgrade the emergency preparedness and response capabilities of all Municipalities in the Greater Toronto Area through which dangerous goods are transported by rail.

4.8 Paying the Costs

If the railways are expected to implement our recommendations to improve the existing system in the course of their normal maintenance and plant upgrading schedule, then it is they who should pay for these improvements.

However, if society demands that these improvements be implemented at an accelerated rate, or that improvements be made over and above that deemed reasonable, then society should pay. Since in the final analysis it is the federal government, as the Regulator of the railways, which dictates requirements to the railways, the federal government should ultimately bear any additional cost burden of an accelerated or enhanced safety program.

In the area of safety Research and Development, the Regulator should ensure that public safety is being properly served. While the railways have much to gain in this area, it must be recognized that Research and Development costs and the implementation of successful Research and Development projects may cost even more. It may be useful to examine ways and means (such as tax incentives or accelerated tax write-offs) to promote rail safety Research and Development. Emergency response costs are more of a local matter between the Province of Ontario, the Municipalities and the railways. Because of the high demand rail yards place on Municipal resources, the railways and the Municipalities (in which these rail yards exist) should work out a reasonable level of railway emergency response demand on the Municipal facilities, over and above which some extra compensation may be warranted. We believe this extra cost should be part of the railways' normal cost of doing business.

4.9 Recommendations

Improving the Existing System

Our recommendations, in this area, are:

System Safety Analysis

- Safety System Analysis be assessed by the railways and the Regulator as an approach to improving public safety and that the Greater Toronto Area be considered for a pilot application of this System Safety Analysis technique.
- The preliminary failure probability and consequence data base established by the Task Force for the Greater Toronto Area be considered as a starting point for the Systems Safety Analysis.

Level of Safety Classification System

- The railways, in conjunction with the Regulator, implement a classification system consistent with statutory speed restrictions and containing a number of levels, applying to all aspects of their fixed plant and train operations.
- This Classification System be made available as public information against which monitoring can be undertaken.

Dangerous Goods Classification Level

- Special Dangerous Goods (DG) levels of classification be established for rail infrastructure and operations carried out in densely populated urban areas where the transportation of special dangerous goods is involved.
- These Dangerous Goods Classification levels be assigned the highest standards of design, construction, inspection maintenance and operation.

Track Quality

- An accelerated program of concrete ties and direct fixation fasteners be undertaken in conjunction with a continuous welded rail program in the densely urban areas of the Greater Toronto Area.

Track Inspection

- A significantly increased and more intense inspection effort be undertaken by the railways in the densely populated urban areas of the Greater Toronto Area.
- These increased levels of inspection be incorporated as part of the designated Dangerous Goods (DG) Classification levels assigned to this area.

Wayside Detectors

- Properly maintained wayside detectors be spaced more frequently than present regulations demand within densely populated urban areas of the Greater Toronto Area.
- This reduced spacing be incorporated into the Dangerous Goods (DG) track Classification level established for such areas.

Advanced Train Control System

- Advanced Train Control System implementation be given top priority and the full support of all concerned.
- The Greater Toronto Area be selected as one of the first locations for the Advanced Train Control System implementation when such technology has been proven.

Concrete Ties and Direct Fixation Fasteners

- As a public safety priority, concrete ties and continuous welded rail be installed in the segmentally-identified high risk areas of the Greater Toronto Area first, followed by other locations in this area.
- This concrete tie program be the subject of a railway/community discussion since increased noise and vibration may result.
- This implementation be subject to an agreed schedule with the Regulator.

Installation of Automatic Half Barriers/Grade Separations

- All attempts be made to reduce accidents at rail/road crossings, where only flashing lights and signage now exist, on lines carrying dangerous goods, through an accelerated program of automatic half barriers with train speed sensor activators.
- All attempts be made to reduce accidents at rail/road grade crossings, on lines carrying dangerous goods, through an accelerated program of grade separations, where sufficient train/motor vehicle volumes warrant such action and where public safety is of concern.
- Public Safety be used as an added criteria in determining the need for grade separations along rail lines carrying dangerous goods in densely populated urban areas.
- The federal government re-instate funding for a meaningful grade separation program.

Tank Car Maintenance, Modification and Repair

- Effective controls and procedures be implemented by the Regulator to ensure that all repairs on tank cars operating in Canada, and more specifically in densely populated urban areas, be of the highest quality and integrity.
- Considering tank car repairs are carried out at shops in both Canada and the U.S.A., this be a subject for the international Joint Railway commission, previously recommended.

Tank Car Research and Development

- Research and Development efforts into ways and means of further improving the crash resistance capabilities of tank cars carrying dangerous goods be vigorously pursued.
- The Minister of Transport, working in conjunction with the U.S. Regulator, (thereby recognizing the cross-border implications of this effort), provide financial support to the specific

area of tank car safety Research and Development.

Train Marshalling

- Where practicable (to be defined by the Regulator after consultation with the railways), heavier rail cars be marshalled at the head end of a train.
- Research efforts, by the Regulator and by industry, into safe marshalling practices, be emphasized and promoted with vigour.

Dangerous Goods Marshalling

- The marshalling and positioning practices and regulations governing Dangerous Goods cars in a train be re-examined.
- Until such time as the above re-examination yields a change, the present regulations governing the positioning of Dangerous Goods cars in a train remain fully in force.
- The British Rail Marshalling Study, when released, be examined carefully by both the Regulator and the railways for application in Canadian railway operations.

Train Length

- Studies be commissioned by the Regulator to determine the effects of the length of a train on its propensity to derail and on the resulting severity of an accident. These studies should be aimed at determining if an optimum, yet practical, train length exists.

Train 'Gateway' Inspections

- Gateway, and other train inspection and monitoring procedures and practices, be given priority consideration in their upgrading and effectiveness.
- The Gateway boundaries, around the Greater Toronto Area, be more frequently reviewed than is now required and altered, as necessary, to accommodate population growth and development.
- For economic and safety reasons, effective automated train monitoring be encouraged and promoted — supplemented, where necessary, by manual inspections and monitoring.
- Enhanced, automated monitoring of special dangerous goods trains be encouraged at gateways to ensure that unsafe conditions do not go undetected as they enter populated urban areas.

The Make Up of Trains (The Consist)

■ The railways agree amongst themselves to a uniform and standard method of producing train consist listings.

■ The railways seek ways of ensuring that train consist listings carried on trains reflect in as timely and in as accurate a fashion as possible, the true make-up of a train at all times.

■ Train consist listings, once operational problems have been overcome, be placed at both ends of a train to facilitate emergency response.

Residue Cars

■ The Regulator, the railways and shippers develop procedures and mechanisms to measure accurately the dangerous goods residue remaining in unloaded pressure tank cars.

Leakers

■ Current procedures and practices involved in the loading, hauling and unloading of dangerous goods be reviewed including the degree to which all personnel (both shippers and carriers) handling these products are adequately trained, alert, and aware of the consequences of their actions.

■ Current regulatory requirements be strictly enforced and repetitions of discovered leakage caused by poor handling at loading and unloading stations should bear heavy penalties.

Mandatory Rest Periods for Train Crews

■ To the maximum extent possible, steps be taken to ensure that fully alert crews are in charge of dangerous goods trains.

Medical Checks for Railway Operating Personnel

■. Railway operating personnel continue to be required to take medical examinations at prescribed times and in a prescribed manner as a prerequisite to maintaining their licences.

■ The process of medical examinations for railway operating personnel be reviewed with that in place for the aviation community to determine areas for improvement, if any.

■ As an assistance to improving public confidence in the railways, the public be made aware that train operating personnel do undergo prescribed medical examinations.

Mandatory Drug/Alcohol Testing

- Rule G, specifying the non-use of drugs or alcohol on the job, or when subject to duty, be maintained and strongly promoted.
- Properly advertised pre-employment screening tests for new employees and for those seeking a reclassification to safety related positions be implemented.
- Testing for 'reasonable cause' also be implemented but with assurances that employee rights and privileges are not abused. (Reasonable Cause to be defined by the Regulator in collaboration with the railways and the railway Unions.)
- Mandatory testing for drug or alcohol usage be undertaken in the case of serious accidents involving death, injury, derailment or collision.
- Employee Assistance Programs be promoted and encouraged along with a training program to increase railway employee awareness as to the seriousness of the consequences of impaired actions, especially involving dangerous commodities.
- Medical checks on employees involved in safety related positions, such as train engineers, include tests for the abusive use of drugs and alcohol.

Human Factor Research and Development

- The human component of the rail system be recognized as a vital and integral part of the total railway system.
- Railway manufacturers, management and unions, in any new train cab development or retrofit program, take ergonomics and the human element into consideration.
- Research resources be applied to understanding the functioning of the human component.
- All research, whether related to human factors or technology, take the impacts on the total rail system into consideration.

Training

- Railway training programs, already technically of a high standard, be complemented with motivational and awareness training.
- Dangerous goods handling courses be significantly enhanced to include, for example, an understanding of emergency response systems, and to view, through videos and the like, demonstrations involving the consequences of dangerous goods accidents (i.e. fires, toxic gases, explosions, etc.).
- Dangerous Goods courses, in addition to the conditions prescribed under the Transportation of Dangerous Goods Act,

include an awareness of the consequences such accidents could have on a community.

- Dangerous Goods courses, for all railway operating personnel, include simulation and other such testing to help ensure an effective emergency response.
- All training courses involve operational personnel more extensively, both in course development as well as in instruction.

Speed

- Since the question of a preferred speed is fundamental to public confidence in the safe operations of trains carrying dangerous goods, an independent, technical review be established to examine our consultants' work with regard to speed.
- Since it has been determined that speed is not the primary or major cause of accidents and since it has been determined that accidents are caused by other factors, attention be given to addressing and removing, on an utmost priority basis, the track, equipment, operational and track defect causes of accidents as identified by the Task Force's consultants, in the densely populated urban areas of the Greater Toronto Area.
- Research and Development work be accelerated into reducing in-train operational forces, harmonic oscillation, wheel climb, hunting and other such causes of accidents.
- The passage of trains carrying dangerous goods in the densely populated urban areas of the Greater Toronto Area be more carefully managed and scheduled in such a way as to ensure that they are not required to change speeds abruptly or unduly.
- To the maximum extent possible, physical, geographic and infrastructural impediments requiring undue speed changes be removed.

Lack of Research Co-ordination

- The Minister of Transport undertake to co-ordinate the railway safety research program in Canada and from this co-ordination determine and address the priority of projects, the funding and the facility requirements necessary to ensure its effectiveness.
- Since it is acknowledged that the rail system is a North American operation, the Minister of Transport, in conjunction with his/her United States counterpart, undertake to co-ordinate the railway safety research program in North America.
- The Minister of Transport ensure that railway safety research objectives are met on a constant and continuous basis, through the implementation of meaningful projects.

Priority Research Projects

- The many safety Research and Development opportunities identified by the Task Force, especially those dealing with the Human Factor, be structured into a co-ordinated and adequately funded program.
- It be recognized that safety Research and Development is of vital importance to the ongoing enhancement of public safety, especially those projects affecting the rail flow of dangerous goods in densely populated urban areas.

Lack of Adequate and Co-ordinated Emergency Plans

- Emergency Response Plans, properly co-ordinated and consistent between the Municipalities and Regions in the Greater Toronto Area, be made mandatory.
- These plans identify specific requirements to respond to railway dangerous goods accidents.

Inadequate Communications and the Need for a Single Spokesperson

- Accurate and timely communications be recognized as a vital component in responding to an emergency and be incorporated in the mandatory plans.
- Emergency Response communications be improved through properly defined roles/jurisdictions of the responders and through the use of one spokesperson communicating with the public.
- Emergency Plans pertaining to the rail flow of dangerous goods in the Greater Toronto Area have input from the two major railways and the chemical/petroleum industries involved.

Lack of Public Awareness

- Emergency Plans, and simulation exercises, include a Public Awareness and Education component through the issuance of information brochures, pamphlets and pertinent emergency response data.

Lack of Emergency Response Access to Rail Lines

- All levels of government, but particularly the provincial and municipal governments, and the railway industry ensure a full and adequate access to all parts of a railway line carrying dangerous goods in densely populated urban areas without encouraging unsafe trespass.
- Provincial and municipal planning guidelines and prac-

tices ensure that adequate and sufficient emergency response requirements are addressed to cope with dangerous goods rail accidents in those areas where rail lines are located.

Lack of Consistency in Railway Emergency Response vis-a-vis Municipalities

- The railways standardize all their operations as they affect emergency response (i.e. consist documentation, emergency procedures, response team duties and responsibilities).
- The railways notify all first responder agencies in the Greater Toronto Area of these standard practices and procedures.
- The railways participate with the Greater Toronto Area first responders in simulation exercises, especially involving the rail flow of dangerous goods.

Railway Demand on Emergency Capabilities

- The railways and Municipalities in which rail infrastructure (primarily rail yards) exists, mutually agree to an adequate provision of emergency response and an appropriate sharing of costs.

Costs and Who Pays

- Operational and infrastructural improvements to the railway system should be borne by the railways if allowed to do so at a reasonable pace and within the normal maintenance and replacement cycles.
- The incremental costs of accelerated programs of railway improvements, or of enhanced levels of public safety in the transportation of dangerous goods in densely populated urban areas over and above that which could reasonably be expected to be borne by an already safety complying, competitive business entity, should be borne by the federal government.
- Incentives and encouragement should be given by the federal government to the railways and other agencies as a way of promoting safety Research and Development, recognizing that any funding mechanism must ensure the conduct of relevant and co-ordinated research.
- Emergency Preparedness and Response costs to meet the minimum requirements for coping with rail dangerous goods accidents should be borne by the Province of Ontario and/or the Municipalities.
- The railways, as a normal cost of doing business, compensate the Municipalities in which rail yards exist for emergency response demands in excess of a mutually agreed level.

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1.0 Introduction and Background

1.1 Task Force Objectives

1.1.A Introduction

The Toronto Area Rail Transportation of Dangerous Goods Task Force was established in March 1986, by the Honourable Don Mazankowski, P.C., M.P., the Minister of Transport at that time. We were asked to examine the feasibility of rerouting and/or relocating the rail flow of dangerous goods in the Greater Toronto Area, and to examine ways of reducing the risks and public safety hazards related to this method of transportation.

1.1.B Our Mandate

Our specific mandate was to inquire into three basic issues, and report our conclusions and recommendations to the present Minister of Transport, the Honourable Benoit Bouchard P.C. M.P.. These issues were:

- The feasibility of rerouting rail traffic transporting dangerous goods within the Greater Toronto Area;
- The feasibility of relocating rail transportation services carrying dangerous goods within the Greater Toronto Area; and
- Any additional requirements governing the safe transportation of dangerous goods by rail.

Our examination of "feasibility" was to be undertaken in the widest possible context. We were to identify and consider:

- The direct and indirect economic costs and benefits involved in options for rerouting or relocating rail traffic transporting dangerous goods;
- Other costs and benefits, both qualitative and quantitative, associated with each option;
- The allocation of all costs involved for each option, and who would assume these costs;
- The impact on communities, shippers and other modes of transportation that may occur as a result of rerouting or relocating;
- The direct and indirect costs and benefits of additional safety requirements governing the transportation of dangerous goods by rail; and
- Methods of implementing the options identified.

1.1.C Our Mandate Enlarged

Before embarking on this mandate, we were given an additional priority task to complete. We were requested by the Minister of Transport to give, within sixty days, our views and recommendations on speed limits for trains hauling dangerous goods on the Canadian Pacific Railway's North Toronto Subdivision line.

We immediately started an intensive study of this question, including a review of:

- current safety statistics;
- past studies of the subject, including the Grange Inquiry into the 1979 Mississauga derailment and the Railway Transport Committee's subsequent Show Cause Hearings;
- the economic, operational and in-transit time impacts of speed limits on both the railway system and the GO Transit commuter network operating in the Greater Toronto Area.

We soon realized that there was little quantitative data on the relationship between train speeds and hazardous accidents. However, after visiting the communities involved, and understanding the unique evacuation difficulties in one particular area, we recommended that the Minister accept the following proposal, put forth by Mr. Glenn Swanson, Canadian Pacific Railway's representative on the Task Force:

- The Canadian Pacific Railway would voluntarily reduce its speed to 25 mph for trains carrying special dangerous commodities (a technical classification), and to 35 mph for trains carrying other dangerous commodities;
- The speed restrictions would apply to the section of track known as the North Toronto Subdivision, which would not affect commuter rail operations yet which would cover the majority of the area under question; and that
- The speed restrictions would be voluntarily maintained by the Canadian Pacific Railway, for the two year life of the Task Force.

The Canadian Pacific Railway made this proposal not because it considered the existing speed limits to be unsafe, or slower speeds to be safer. It made the proposal because it recognized the high degree of public concern surrounding this issue, and it wanted to ensure that the Task Force's work could proceed in a positive environment.

The proposal was, however, conditional on our mandate being enlarged to include a study into the effects of speed on the incidence and severity of accidents, and an examination of the public's perception of the safe transportation of dangerous goods by rail.

The Minister of Transport accepted our recommendations and our mandate was enlarged accordingly.

1.1.D Scope

Our mandate covered the Greater Toronto Area, extending 135 kms from Bowmanville/Newcastle in the east to Burlington in the west, and from Lake Ontario to just south of Orangeville and Lake Simcoe in the north and Lake Scugog in the upper east quadrant. (See Exhibit 1.1) The area covers 1,405,000 hectares (5,425 sq. miles), includes 35 municipalities and five regions (see exhibit 1.2) and has a population of 3.6 million persons. It is also the major hub of operations for Canada's two largest railways.

Many of the issues we studied, however, extended beyond this geographic scope, with national and international implications. Safety issues such as the role of the Regulator, the regulatory process, the need for national safety objectives, technological improvements, human factors such as drug and alcohol abuse all transcend the Greater Toronto Area. But they are critical to public safety, and had to be addressed in our work.

1.1.E Special Issues

To assist us in our task, we commissioned detailed consulting studies on a variety of topics. These are outlined in Exhibit 1.3 below.

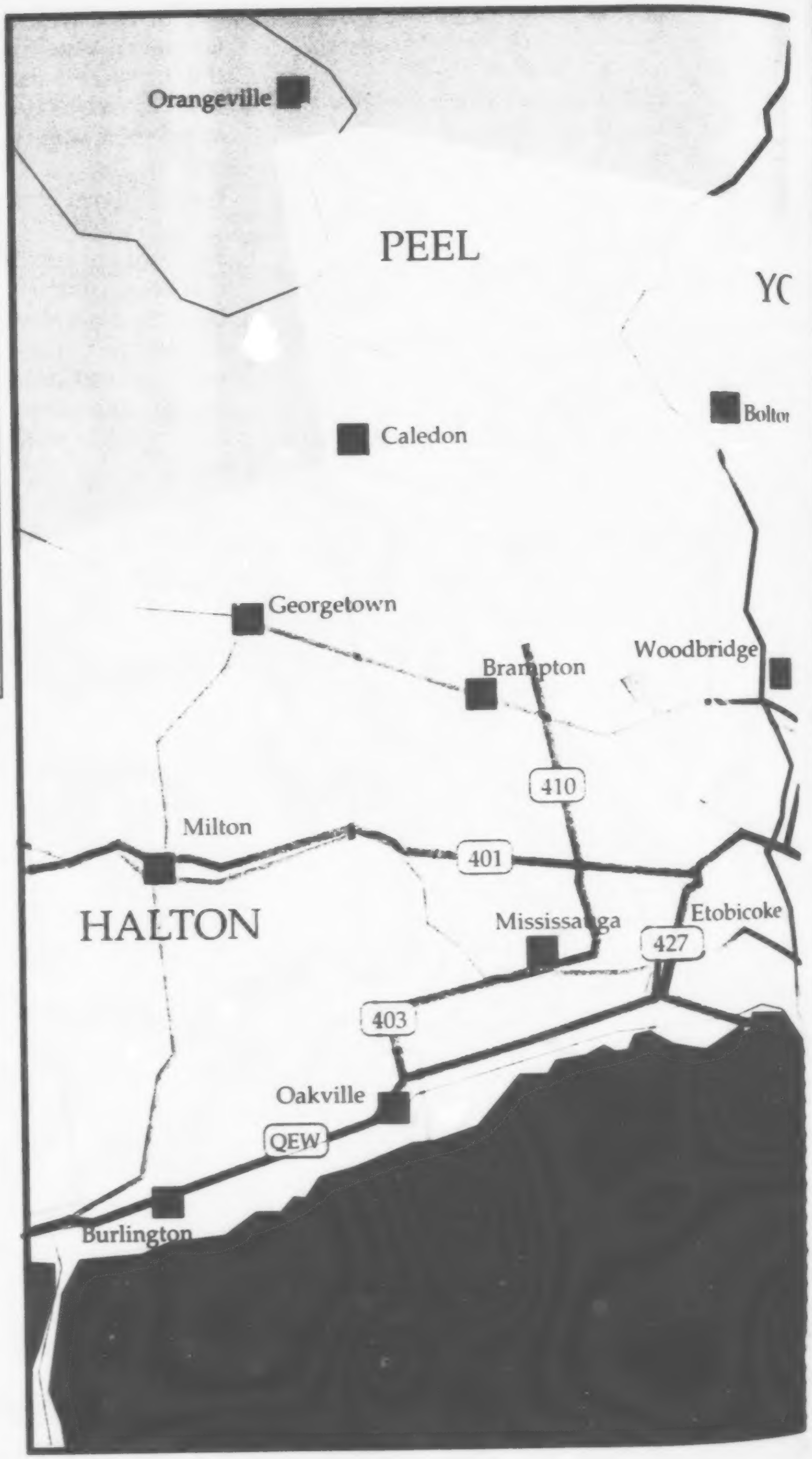
While these studies formed the core of our investigations, we studied a large number of other issues ranging from such questions as 'Who manages rail safety in Canada?' to 'How well do Canada's rail crews discharge their duties?'. We report on all these issues in this Report.
We have given due consideration to all information received, regardless of origin; we have not felt obligated to accept any data at face value, even from our own consultants. We wanted to be free to deliberate and weigh all the evidence, and to render our own judgement. This we have done.

Where there have been differences in views amongst the Task Force members, these views have been so indicated along with the number of members holding an opposite view.

1.1.F Domestic and Foreign Experience

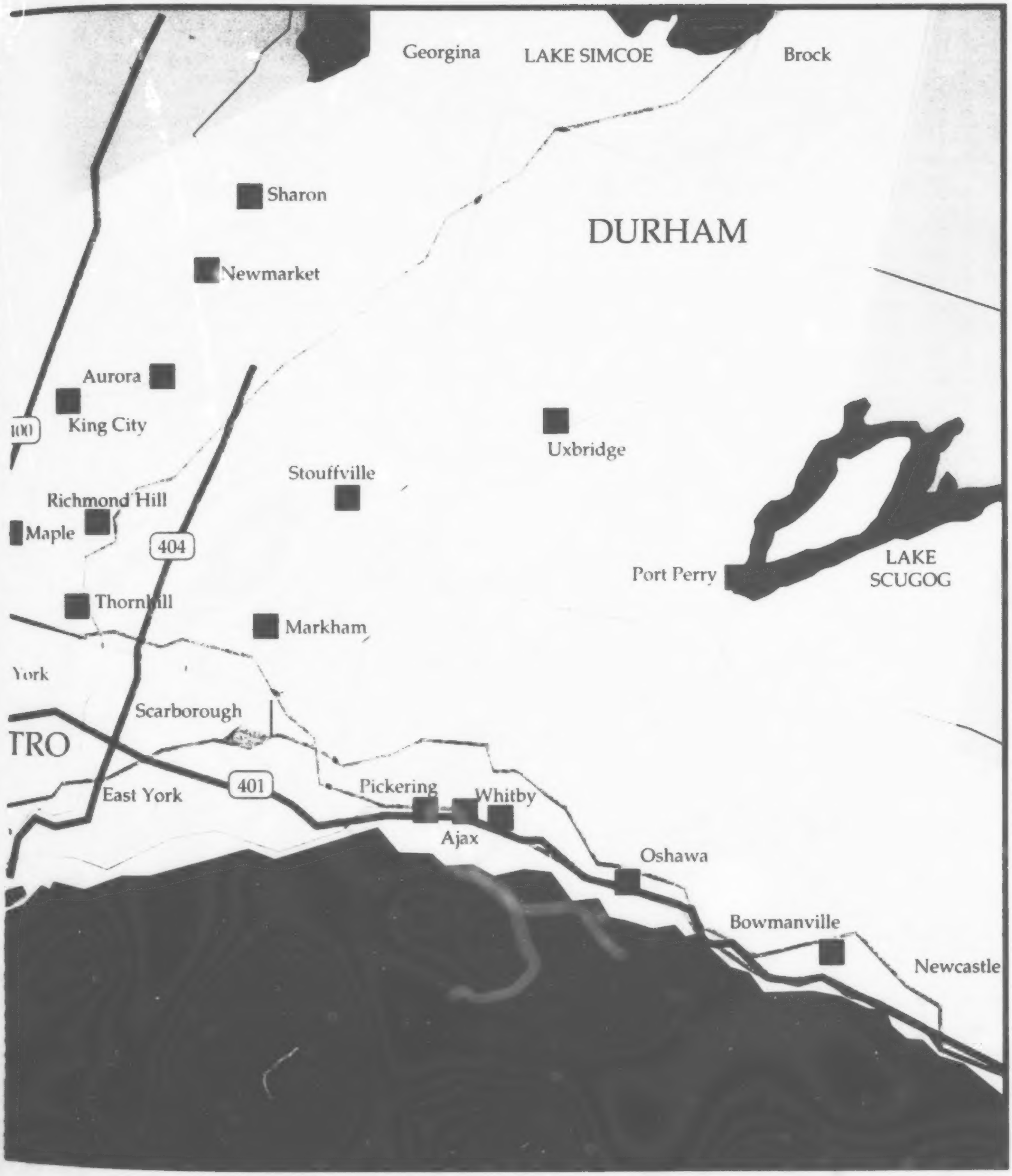
We communicated with a number of other countries on the topic of transporting dangerous goods by rail in densely populated areas. We wrote and sent questionnaires to West Germany, Great Britain, the Netherlands, Sweden, Norway,

Exhibit 1.1
The Greater Toronto Area


404 Highway System
Existing Rail Corridors and Yards
Lakes
Towns, cities
Regional Boundaries
Orangeville
PEEL
YC
Bolton
Caledon
Georgetown
Brampton
Woodbridge
410
Milton
401
HALTON
Mississauga
Etobicoke
427
403
Oakville
QEW
Burlington

This map shows the existing rail corridors and major road systems and their locations in relationship to key population centres

ods Study Area



Georgina
LAKE SIMCOE
Brock
Sharon
DURHAM
Newmarket
Aurora
King City
00
Uxbridge
Stouffville
Richmond Hill
Maple
404
LAKE
SCUGOG
Port Perry
Thornhill
Markham
York
Scarborough
TRO
401
East York
Pickering
Whitby
Ajax
Oshawa
Bowmanville
Newcastle

Exhibit 1.2
Listing of Regional and Local Municipalities

Durham

Regional Chairman G.Herrema
Regional Municipality of Durham
Box 623, Rossland Rd. E.
Whitby, Ontario
L1N 6A3

Mayor A.C.Pilkey
City of Oshawa
50 Centre St. S.
Oshawa, Ontario
L1H 2Z7

Mayor W.G.McLean
Town of Ajax
65 Harwood Ave. S.
Ajax, Ontario
L1S 2H9

Mayor J. Winters
Town of Newcastle
40 Temperance St.
Bowmanville, Ontario
L1C 3A6

Mayor J.E.Anderson
Town of Pickering
1710 Kingston Rd.
Pickering, Ontario
L1V 1C7

Mayor R.A.Attersley
Town of Whitby
575 Rossland Rd. E.
Whitby, Ontario
L1N 2M8

Mayor A.G.McPhail
Township of Brock
P.O.Box 10
Cannington, Ontario
L0E 1E0

Mayor DJ Taylor
Township of Scugog
P.O. Box 209, 181 Perry St.
Port Perry, Ontario
L0B 1N0

Mayor GL O'Connor
Township of Uxbridge
P.O. Box 190, 20 Bascom St.
Uxbridge, Ontario
L0C 1K0

York

Regional Chairman E.King
Regional Municipality of York
P.O. Box 147, 62 Bayview Ave.
Newmarket, Ontario
L3Y 4W9

Mayor J.G.West
Town of Aurora
50 Wellington St. W.
Aurora, Ontario
L4G 1L8

Mayor R. Featherstonhauth
Town of East Gwillimbury
18066 Leslie st.
Sharon, Ontario
L0G 1V0

Mayor C.Bell
Town of Markham
8911 Woodbine Ave.
Markham, Ontario
L3R 1A1

Mayor R.J.Whinney
Town of Newmarket
Box 328, 171 Main St.
Newmarket, Ontario
L3Y 4X7

Mayor A.Duffy
Town of Richmond Hill
17266 Yonge St.
Richmond Hill, Ontario
L4C 4Y5

Mayor L.Jackson
Town of Vaughan
2141 Major McKenzie Drive
Maple, Ontario
L0J 1E0

Mayor F.Sainsbury
Town of Whitchurch-Stouffville
Box 419, 19 Civic Ave.
Stouffville, Ontario
L0H 1L0

Mayor J.Rogers
Township of Georgina
Civic Centre Road
Keswick, Ontario
L4P 3E9

Mayor C.W.Jessop
Township of King
RR#2
King City, Ontario
L0G 1K0

Metro

Chairman C.D.Flynn
Municipality of Metropolitan Toronto
New City Hall
100 Queen St. West
Toronto, Ontario
M5H 2N1

Mayor G.B.Sinclair
City of Etobicoke
Civic Centre
Etobicoke, Ontario
M9C 2Y2

Mayor M.Lastman
City of North York
North York, Ontario
M2N 5V7

Mayor G.Harris
City of Scarborough
Civic Centre
150 Borough Drive
Scarborough, Ontario
M1P 4N7

Mayor A.Eggleton
City of Toronto
New City Hall
100 Queen St. W.
Toronto, Ontario
M5H 2N2

Mayor A.Tonks
City of York
2700 Eglinton Ave. W.
Toronto, Ontario
M6M 1V1

Mayor J.D. Johnson
Borough of East York
550 Mortimer Ave.
Toronto, Ontario
M4J 2H2

Peel

Regional Chairman R.F.Bean
Regional Municipality of Peel
10 Peel Centre Drive
Brampton, Ontario
L6T 4B9

Mayor K.G.Whillans
City of Brampton
150 Central Park Drive
Brampton, Ontario
L6T 2T9

Mayor Hazel McCallion
City of Mississauga
1 City Centre Drive
Mississauga, Ontario
L5B 1M2

Mayor E.Kolb
Town of Caledon
P.O. Box 1000, 200 Church St.
Caledon East, Ontario
L0N 1E0

Halton

Regional Chairman P.D.Pomeroy
Regional Municipality of Halton
P.O. Box 7000, 1151 Bronte Rd.
Oakville, Ontario
L7R 1E6

Mayor R.Bird
City of Burlington
P.O. Box 5013, 426 Brant St.
Burlington, Ontario
L7R 3Z6

Mayor R.T.Miller
Town of Halton Hills
P.O. Box 128, 36 Main St. S.
Georgetown, Ontario
L7G 4T1

Mayor G.A.Krantz
Town of Milton
P.O. Box 1005, Victoria Park Square
Milton, Ontario
L9T 4B6

Mayor W.P.Perras Jr.
Town of Oakville
P.O. Box 310, 1225 Trafalgar Rd.
Oakville, Ontario
L6J 5A6

Exhibit 1.3 Studies Undertaken By Consultants

Project Name	Consultant	In Association with	Task to be Undertaken
Alternative Routes and Operational Strategies	IBI Group	Morrison Hershfield Ltd., Transmode Consultants Inc.	Determine the feasibility of various routes for rail transportation of dangerous goods using (a), primarily existing track (rerouting); or using (b), primarily, newly-constructed track (relocation). Examine the use of other operating strategies for improved safety. Investigate all options for cost, impact on railways, shippers, public, communities, environment etc. Evaluate the benefits to be derived, by possible train operations, of the opportunities made available through diversion, to other tracks, of trains carrying dangerous goods.
Study of Possible Land Uses Evaluation	Engineering International	Royal Lepage Real Estate Services Limited, Transmode Consultants Inc.	Evaluate imaginative uses to which the CPR North Toronto Subdivision and the CPR Agincourt Yard could be put if they were totally abandoned for rail purposes. This evaluation will consider adjacent lands and conjunctive development.
Study of Buffer Zone Protection and Ways and Means of Preventing Future 'Corridor Encroachment'	Delcan	McCarthy and McCarthy Barristers and Solicitors	Identify and examine underlying causes of encroachment of development up to rail corridors and development of incompatible uses. Examine land use or zoning restriction practices elsewhere and suggest ways by which development can be managed. Where development is incompatible with existing transportation uses, or where it encroaches on buffer zones created to reduce consequences of a dangerous goods incident, recommend solutions or alternatives.
Emergency Preparedness and Response	Institute of Environmental Research (1985) Inc.	Concord Scientific Corporation, Georesource Consultants Inc.	Examine the present degree of emergency response and preparedness existing in the various municipalities. Determine responsibilities and legislation and what if any, responsibility gaps exist. Determine what is required in terms of hardware, personnel, training etc. and estimate the costs and allocation for bringing the 'Response System' up to a satisfactory level, if such is deemed necessary.
Assessment of Risk	Concord Scientific Corporation	Canadian Institute of Guided Ground Transport, Chemical Engineering Research Consultant Ltd., Delcan	Undertake an analysis of the risk to public safety for the alternative routes and operational strategies in this project. Identify potential hazards, their causes and likelihood (probability) of occurrence, the associated hazard zones and risk to public safety for each of the alternatives.
Management of Risk	Concord Scientific Corporation and IBI Group		Using examples, outline the ways risk is handled in everyday life and the risks commonly encountered. Compare the risk for the various routing and operational alternatives with the costs, impacts and consequences and describe risk mitigation measures for the rail transport of dangerous goods.
Technology Assessment and Safety Administration	Cole, Sherman Transmark Inc.		Compare Canadian railways versus the 'state of the art' in technology development; what technology advances can be implemented; and what reductions in accident probability will result. Examine the legislative and regulatory requirements in Canada, in USA, and practices elsewhere with respect to safety. Identify alternatives for Canada as an independent nation as well as consider the rail transportation interface with the US railways. Also examine the role of research and development as it contributes to safety and recommended ways of encouraging a proactive position in this area.
Study of Relationship Between Train Speed and Incidence and Severity of Accidents	Delcan	Transportation and Distribution Associates	Investigate the historical record of the relationship between the frequency of accidents and the severity of these accidents. Focus on the causes of accidents, the resulting degree of damage to both train equipment and wayside facilities, and the effect of speed on equipment, track, roadbed and maintenance. Study and recommend a 'Safe' speed range for various types and condition of track.
Public Perception Survey	Ekos Research Associates Inc.		Determine from the public at large, their awareness of risk in the rail transportation of dangerous goods; whether this risk is real or perceived; and compare the perception of this risk to that of other transportation modes. Also determine attitude towards the railways in general and explore options for improvement.

Finland, Denmark, Australia, France, Japan, and 15 States of the USA.

We had detailed discussions with the executive and staff of the United Kingdom's Health and Safety Executive, Department of Transport, British Rail, and the British Chief Inspecting Officer of Railways. In the US we visited the offices of the Federal Railway Administration and the Research and Special Projects Administration, both in Washington D.C. and in Boston, Mass. We also visited officials of the National Transportation Safety Board and the Association of American Railroads.

We visited the U.S. cities of Chicago, Boston, Houston and San Antonio to learn how they handled dangerous goods by rail. These cities were chosen because of similarities with the Greater Toronto Area either in present size, future population density, experience with a major derailment, and/or high volumes of dangerous goods traffic.

Here in Canada we met with officials of the National Research Council, the Transport Development Centre, the Canadian Transport Commission and its sub-committee the Railway Transport Committee, and the Department of Transport. We visited the laboratories and facilities of the Canadian National Railways and the Canadian Pacific Railway. We also carried out extensive field trips in the Greater Toronto Area.

1.1.G Public Consultations

Throughout our work we maintained an extensive public consultation program. We conducted two widely advertised public information sessions, ending with two days of public hearings. We issued regular Progress reports. We listened to the elected officials at the local, regional and federal levels, including thirty-five mayors and councils, five regional chairmen and councils, and thirty-seven federal Members of Parliament.

All requests to be heard were granted. During the course of our deliberations we heard briefs and presentations from 64 individuals or organizations, answered numerous telephone calls and received 125 written submissions.

1.1.H Organization of this Report

The entire Task Force submission to the Minister of Transport comprises fifteen volumes. Aside from a summary of our Final Report and the Final Report itself, it includes one volume summarizing the studies undertaken by our consultants; nine volumes of complete consultant's reports; and three volumes of submissions sent to the Task Force. The latter set includes a detailed list of submitters and a graphic analysis of the issues they raised.

This volume contains our Final Report. It is organized as follows:

Chapter 1 includes this introduction, and the historical background which follows;

Chapter 2 examines the topic of Public Safety, with suggestions for improving the relevant regulatory and legislative mechanisms;

Chapter 3 investigates, as a longer term option in the Greater Toronto Area, the issue of rerouting and relocating the rail flow of dangerous goods, the risks involved, and the need for buffering;

Chapter 4 discusses ways to improve the existing system, as a short term option, in such areas as technology, train operations, human factors, speed, research and development, and emergency response;

Chapter 5 provides a Summary of Recommendations.

Appendices include our Terms of Reference, a comprehensive list of submissions received, and an extensive review of what we learned from other countries.

1.1.I Legal Authority

Our legal authority is contained in the Government of Canada's Order-in-Council PC-1984-2241, June 22, 1984 SOR/86-332 brought into effect on March 7, 1986 and announced, by press release, on March 14, 1986.

1.1.J Conclusion

This has been a challenging assignment. The focus of our concern has been Canada's largest metropolitan region - one where any accident involving dangerous goods could put the health and safety of large numbers of people at risk. To our knowledge, this is the most comprehensive and exhaustive study of its kind ever undertaken. We are pleased to have been able to contribute our services.

1.2 Background

1.2.A Introduction

Transportation of dangerous goods by rail is not a new phenomenon, but in recent years it has caused increasing public concern. The 1979 Mississauga derailment of a train carrying propane and chlorine, which caused the evacuation of almost a quarter million people, is one reason for this concern, but it is not the only one. Other rail accidents, the Bhopal chemical accident in India, and the Chernobyl nuclear accident in the U.S.S.R. have all heightened public awareness of the risks involved with dangerous substances.

The following discussion outlines the historical background to the transportation of dangerous goods by rail, and some of the contextual issues affecting such transportation in the Greater Toronto Area.

1.2.B Regulating the Transportation of Dangerous Goods by Rail

In the late 1800s and early 1900s, the rail system consisted of small freight cars, travelling short distances at slow speeds, using a relatively simple infrastructure of signals and trackage. People living near rail lines had little concern about what goods the trains were carrying.

Today, trains are heavier, and travel farther at high speeds. Rail technology is highly sophisticated. And those cargoes designated as dangerous goods can — if derailed and released — affect large populations living near the rail lines.

Although there were no fatalities, the hazards involved with such cargos were highlighted by the 1979 derailment in Mississauga. In 1981 the Transportation of Dangerous Goods Act was passed into law. Under this Act and Regulations, and under the regulations set by the Canadian Transportation Commission, shippers, carriers and receivers of dangerous goods are required to identify and classify these goods, and ensure that persons handling them are aware of the hazards involved. The Regulations set out the training required for handling dangerous goods, and mandate that appropriate actions be taken in the event of an emergency.

The federally-regulated railways are also governed by the Railway Act, soon to be replaced by the Railway Safety Act. The latter will govern the requirements for the railways' infrastructure, equipment, train operations and speed. The Transportation of Dangerous Goods Act governs product handling.

1.2.C Definitions of Dangerous Goods

A detailed listing of dangerous goods is published by the Dangerous Goods Directorate of Transport Canada. With some modifications, the classification follows that set by the United Nations. Over 3000 products are assigned to one or more of nine classes, based on the type of hazard involved.

The definitions used in this Report are consistent with the classifications set by Regulation. We are satisfied that these definitions fully cover all the products shipped by rail in the Greater Toronto Area, and truly reflect their danger to the community. The basic definitions are as follows:

- **Special Dangerous Commodities:** which include substances such as explosives, toxic or corrosive gases and liquids, and which could cause significant harm beyond the immediate rail right-of-way if released (Examples include chlorine, propane and anhydrous ammonia).
- **Dangerous Commodities:** substances which generally cause harm only within the right-of-way if released, such as gasoline. Some of these products may cause harm beyond the right-of-way
- **Dangerous Goods:** both Dangerous Commodities and Special Dangerous Commodities.
- **Dangerous Mixed Carloads:** packaged dangerous goods generally carried in boxcars, trailers and containers along with other packaged goods, which could cause a hazardous situation, usually within the right-of-way, if released (examples include butane lighters and batteries).
- **Residue Cars:** rail tank cars that have carried dangerous goods; have been discharged; but may still contain a residual amount of product up to two per cent of the car's volume. These cars may contain vapours and may be backloaded with other products such as methane. Pressure however must be below 25 psi.

1.2.D The Greater Toronto Area Rail System

Canada's two major freight railways, the Canadian National Railways and the Canadian Pacific Railway, both run through the Greater Toronto Area. In fact, the major hub operations of both railways are located here.

Before the 1960s, both Canadian National and Canadian Pacific operated a similar system in the area, including downtown classification yards. However, when constructing the bypass route of the Halton and York subdivisions, Canadian National built a new yard in the Township of Vaughan. This allowed Canadian National trains to go around the edge of the built-up areas rather than the centre of the City of Toronto.

At the same time Canadian Pacific moved its major activities from West Toronto to its new Agincourt yard. But no new

Canadian Pacific lines were constructed, and trains continue to run through the centre of the City.

Exhibit 1.4 shows the rail system as it is today. Essentially, this system has been in place since the early 1960s, and it has served the Greater Toronto Area well.

But today there are increasing signs of incompatibilities between the system and the surrounding communities. With the population growing rapidly, urban development is consuming scarce land resources, especially along the rail lines which carry dangerous goods. This is the main reason the Task Force was asked to examine the feasibility of rerouting or relocating such rail traffic.

1.2.E Contextual Issues

A Growing Population

In 1985 the Greater Toronto Area held 40% of Ontario's population, and it is growing. According to Statistics Canada figures, between 1983 and 1987 more Canadians moved to this area than any other part of Canada. And from 1985 to 1987, the area received 80% of Canada's total immigration.

This extensive population growth has created enormous pressures for development in the municipalities and regions of Greater Toronto. Exhibit 1.5 shows the estimated growth patterns to 1991 and 2011, and the dramatic ballooning effect these are having. This rapidly expanding population would be affected by any rerouting or relocation of dangerous goods rail traffic.

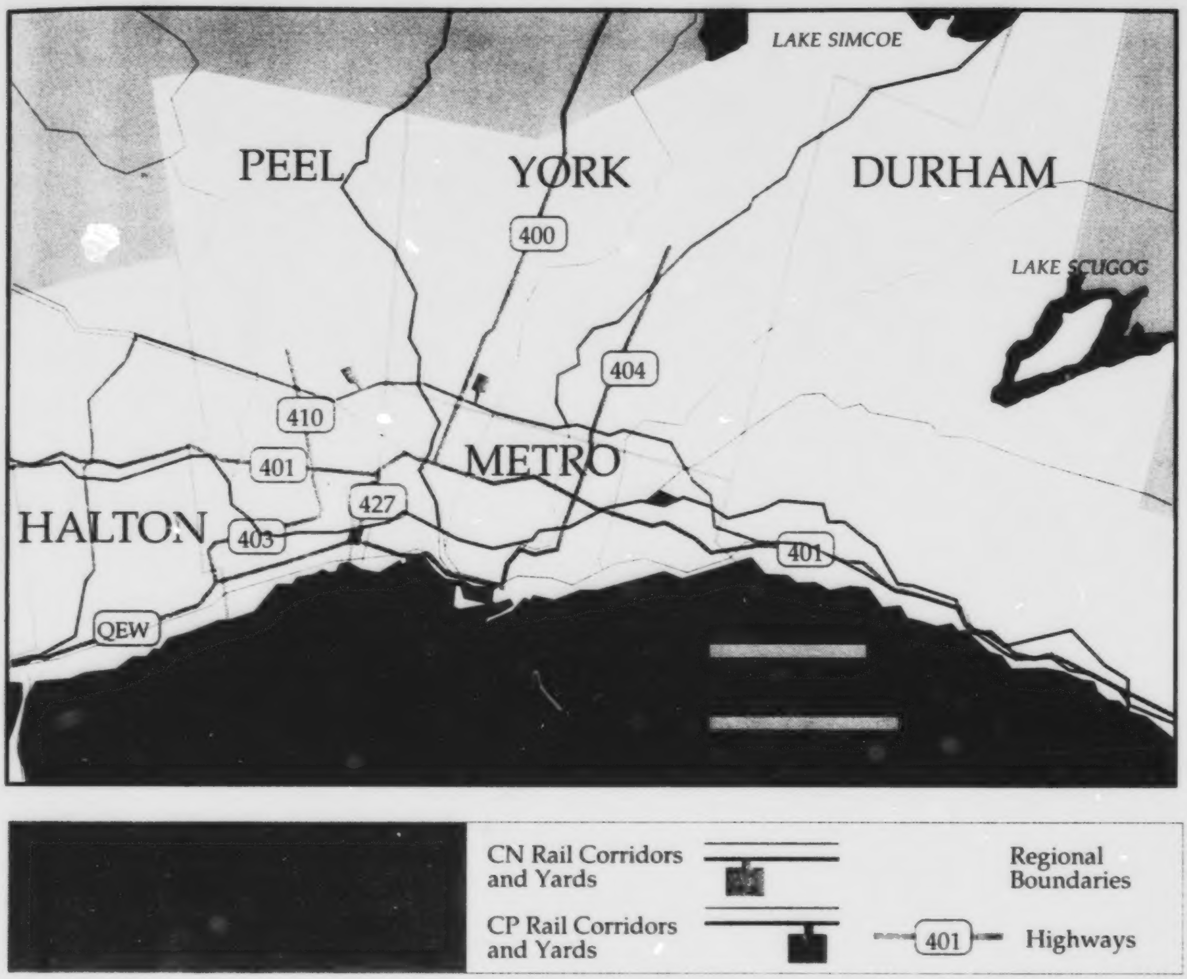
The Road Transportation Network

As a major industrial, commercial, tourist and cultural centre, the Greater Toronto Area has a transportation infrastructure equalling the best in the world. Its freeway system, the finest in North America, provides excellent road access in both an east/west and a north/south direction.

Even so, traffic congestion is occurring. There are concerns and debate about whether rerouting or relocating rail traffic would result in a shift of volume to trucks — which may be a more hazardous transportation mode when dangerous goods are involved, and would complicate an already congested highway system.

GO Transit Commuter Service

A provincial agency called GO Transit began running com-

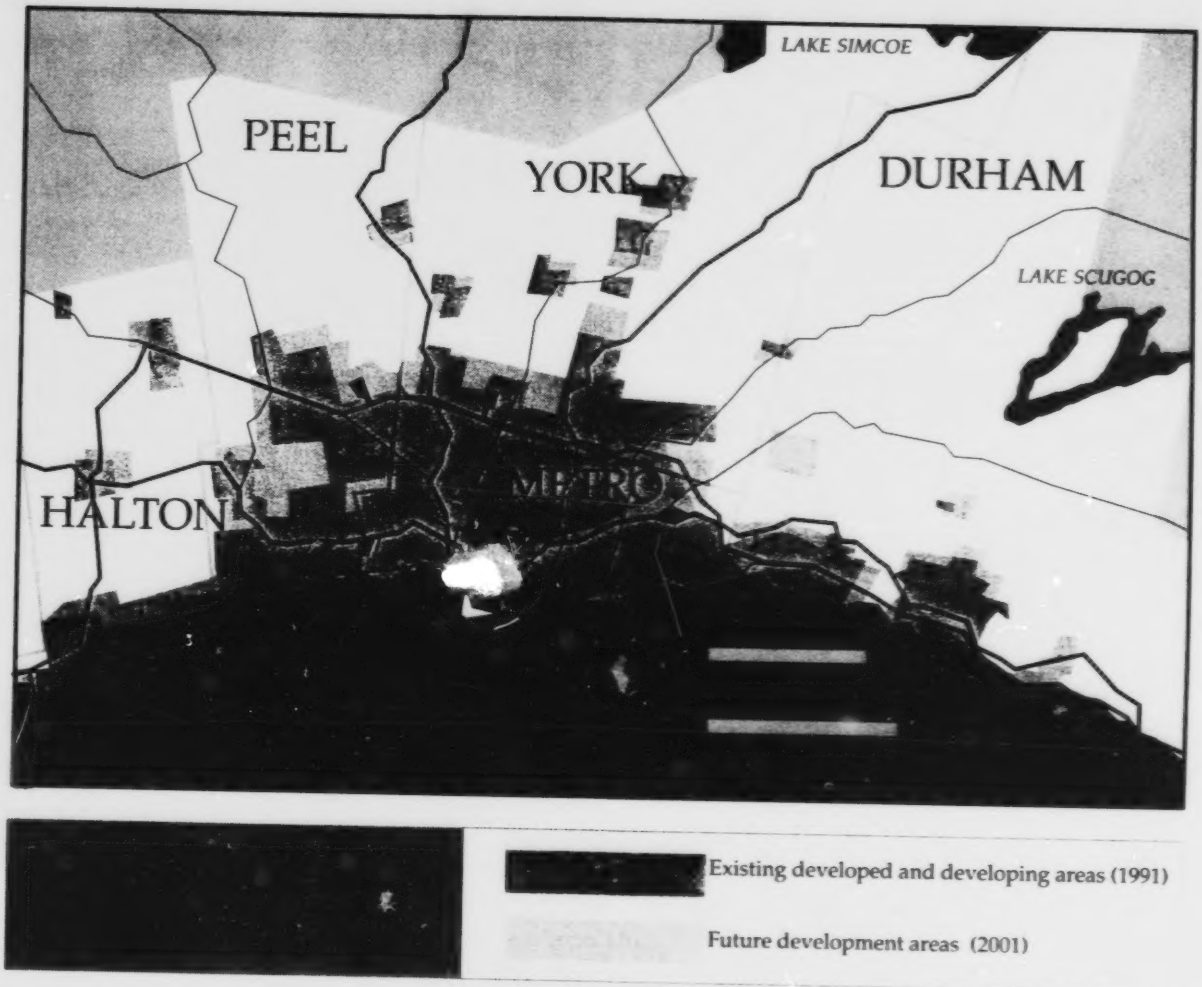

LAKE SIMCOE
PEEL
YORK
DURHAM
400
LAKE SCUGOG
404
410
401
METRO
427
HALTON
403
401
QEW
CN Rail Corridors and Yards
Regional Boundaries
CP Rail Corridors and Yards
401
Highways

muter rail services on the Lakeshore Corridor in 1967. It has since expanded to other radial lines, and new services using both Canadian National and Canadian Pacific track are being considered. The service carries over 60,000 rail commuters a day.

Clearly, the effects on GO Transit must be considered in any option affecting the movement of dangerous goods along tracks used by the service. For example, Canadian Pacific's proposal to apply voluntary speed limits (discussed above) was carefully designed not to affect operations of the GO Transit system.

VIA Rail

VIA Rail is responsible for all intercity passenger rail service in Canada. In our discussions with VIA, they told us that to compete effectively with other modes of transportation they


LAKE SIMCOE
PEEL
YORK
DURHAM
LAKE SCUGOG
HALTON
METRO
Existing developed and developing areas (1991)
Future development areas (2001)

need to be assured of controlled in-transit timing, good trackage and signal maintenance, and sufficient capacity to handle demand in the Greater Toronto Area. These needs must also be considered in any rerouting or relocating of dangerous goods rail traffic.

Dangerous Goods 'Through' Traffic

Individuals, ratepayer groups and elected officials repeatedly raised the issue of dangerous goods 'through' traffic. Most of the dangerous goods transported by rail in Greater Toronto comes from outside the area and is headed for other destinations (see Exhibit 1.6).

It seems to be accepted that dangerous goods originating in or destined for Greater Toronto should continue to flow on existing lines. But we do not feel that the reverse is automatically true — that is, that other dangerous goods should, as a

Exhibit 1.6
Summary of Dangerous Goods Flows By Rail

Annual Carloads - 1985

C.N. Traffic	**Local**	**Through**	**Total**	**% Through**
Dangerous Mixed Loads	13810	1692	15502	10.9%
D.C. Car Loads	3288	6425	9713	66.1%
S.D.C. Car Loads	1369	10770	12139	88.7%
All Dangerous Goods Car Loads	18467	18867	37354	50.6%
Non-dangerous Car Loads	280057	271752	551809	49.2%
Residue D.G. Tank Cars	4949	16372	21321	76.8%
Non-dangerous Residue Cars	158428	231465	399893	57.9%
Total Cars	**471901**	**538476**	**1010377**	**53.3%**
C.P. Traffic				
Dangerous Mixed Loads	9312	980	10292	9.5%
D.C. Car Loads	2594	9952	12546	79.3%
S.D.C. Car Loads	1165	5283	6448	81.9%
All Dangerous Goods Car Loads	13071	16215	29286	55.4%
Non-dangerous Car Loads	235793	185157	421950	44.1%
Residue D.G. Tank Cars	2574	13249	15823	83.7%
Non-dangerous Residue Cars	123150	33326	156476	21.3%
Total Cars	**374588**	**248947**	**623535**	**39.9%**
Total Traffic				
Dangerous Mixed Loads	23122	2672	25794	10.4%
D.C. Car Loads	5882	16377	22259	73.6%
S.D.C. Car Loads	2534	16053	18587	86.4%
All Dangerous Goods Car Loads	31538	35102	66640	52.7%
Non-dangerous Car Loads	515850	457909	973759	47.0%
Residue D.G. Tank Cars	7523	29521	37144	79.7%
Non-Residue Cars	291578	264791	556369	47.6%
Total Cars	**846489**	**787423**	**1633912**	**48.2%**

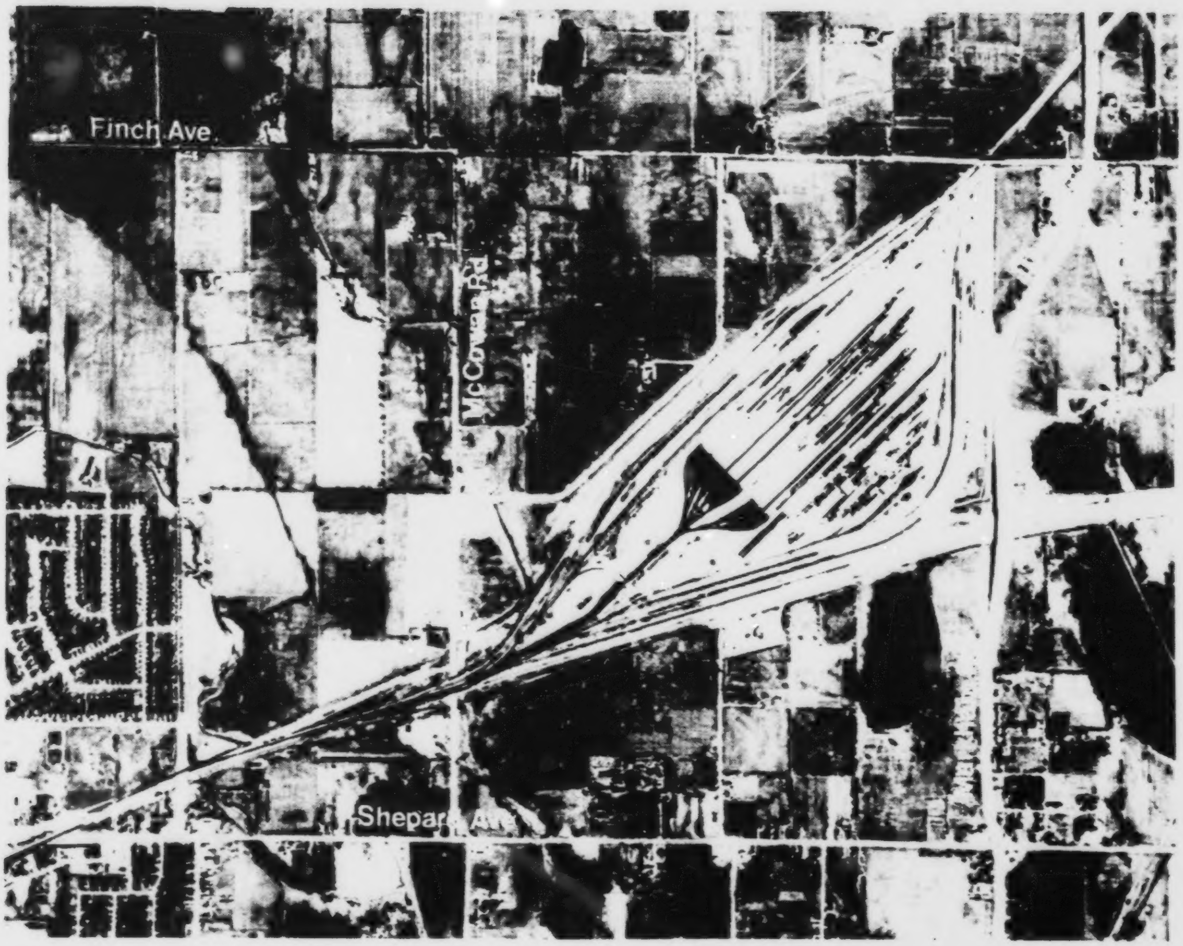
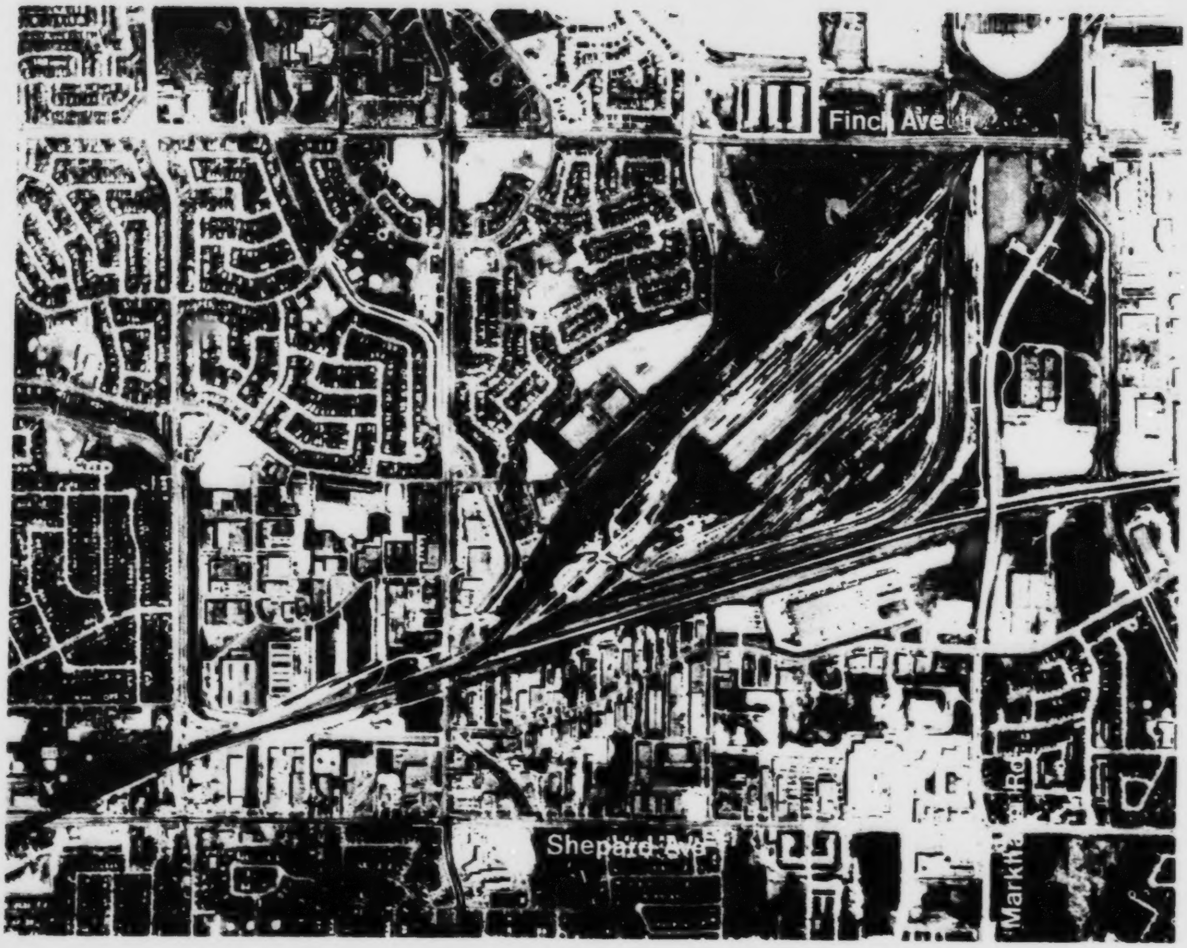

Finch Ave.
McCowan Rd
Sheppard Ave.

Exhibit 1.7
Canadian Pacific
Agincourt Yard

1965 Development


Finch Ave
Shepard Ave
Markham Rd

1983 Development

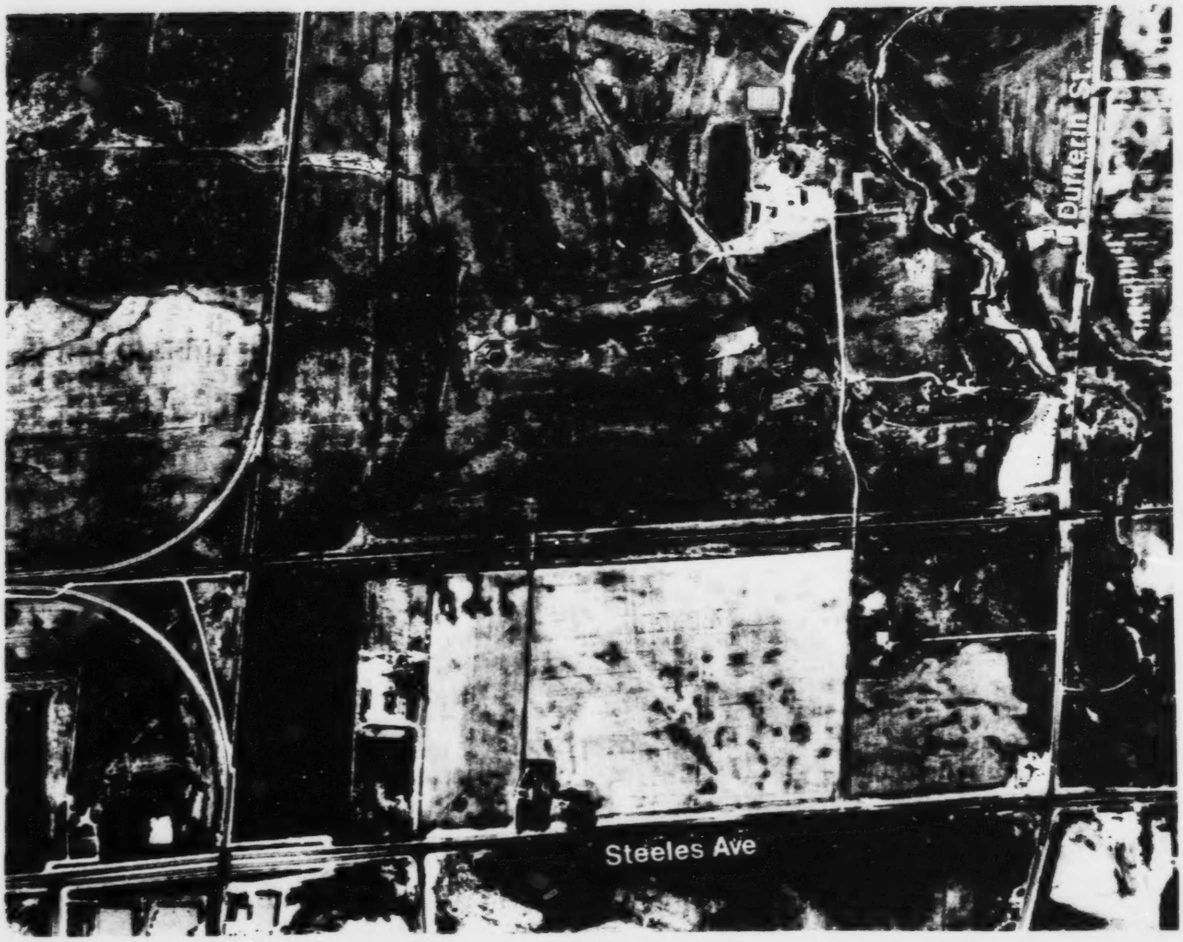
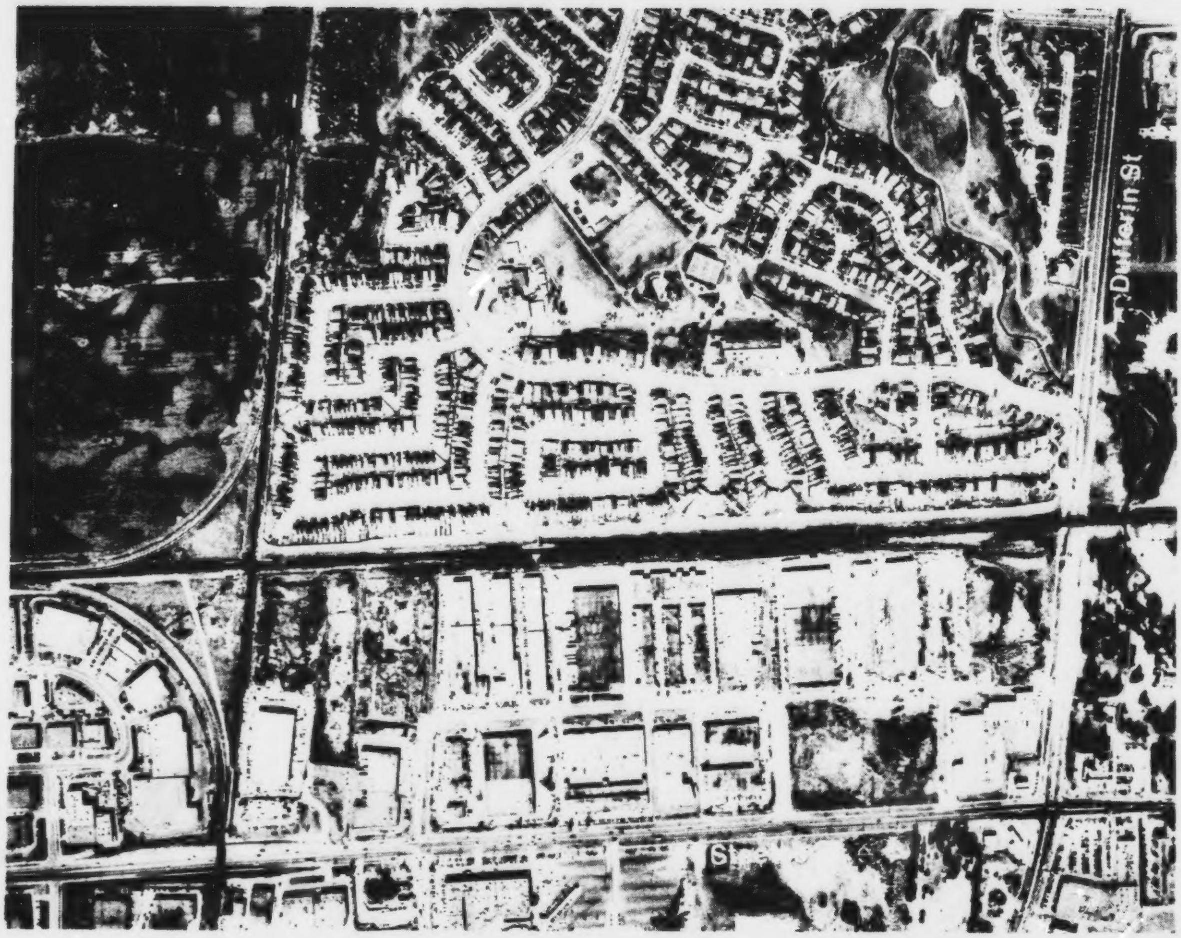

Dufferin St
Steeles Ave

Exhibit 1.8
Canadian National
York Subdivision

1975 Development


Dufferin St

1987 Development

matter of principle, be rerouted. The origin and destination of such goods are important factors to consider, but not the only ones.

Urban Development and Encroachment

In the 1960s, both Canadian National and Canadian Pacific built extensive infrastructures in sparsely populated parts of the area (Canadian National's Halton-York line and Canadian Pacific's Agincourt Yard; see Exhibits 1.7 and 1.8). But these facilities were quickly surrounded by developments adjacent to the railways' rights-of-way.

The railways have consistently tried to persuade officials that more protection, or 'buffering', was needed to separate their lines from residential developments. As an illustration based on documents we viewed, Canadian National predicted ten years ago exactly what is occurring today, where developments are allowed adjacent to existing lines.

We discuss the issue of buffering in Chapter 3.12. But it is important to see the encroachment problem in context from the beginning. Lack of foresight on this issue is perhaps the major cause of our concerns today.

2.0 Public Safety

2.1 Public Safety

2.1.A Introduction

Our Terms of Reference may seem to imply an exclusive focus on rerouting or relocating rail lines in Greater Toronto. But rerouting and relocation are only means to an end — the safety of the general public. Above all, our mandate was one of enhancing public safety, and that goal was pre-eminent in all our deliberations.

As part of that goal, we were also committed to an overall reduction of risk in the Greater Toronto Area — not simply a shift of risk from one community to another. The submissions we received, the presentations we heard, and the Resolutions from elected Councils all supported this commitment; no one expressed any desire to shift risk onto others. (Our Public Perception Survey and Analysis of Submissions Received are appended as separate volumes to this report.)

This chapter presents our views and recommendations on the broader issues of public safety as they apply not only to the Greater Toronto Area, but may apply to Canada as a whole.

2.1.B The Scope of Public Safety Issues

The railway system in Canada is a continuous network from one end of the country to the other. In fact, because of our enormous trade with the United States, that network extends well beyond our borders.

Because Greater Toronto is just one part of that network, we could not limit our studies to the Greater Toronto Area alone. It would simply not be possible to have a safe rail system within Greater Toronto, if the system as a whole was unsafe on either side of the area. We had to take a broader look at the structures and mechanisms designed to:

- Encourage and promote a safe rail system throughout Canada, as well as in the Greater Toronto Area; and
- Ensure that safety is continuously maintained through effective safety objectives, monitoring procedures and inspections.

To this end, we carried out a comprehensive review of the organizations and mechanisms which regulate Canada's railways, as well as those used in other countries. We held extensive consultations with the regulatory bodies in Canada, the U.S. and Britain, as well as representatives from the U.S. cities of Boston, Chicago, Houston and San Antonio. We corresponded with 11 countries and 15 States of the United States. We commissioned consultants to examine what made the systems in other countries work, and how Canada could learn from their examples.

We found that the Canadian railway system, including both Canadian National Railways and Canadian Pacific Railway, is one of the safest in the world. At the same time, we found an industry that is highly regulated — often over-regulated — in a way that focuses more on operational restrictions than on incentives to perform safely, efficiently and effectively. We believe that several changes must be made if Canada is to maintain its safety record, and improve that record in the future.

2.1.C Safety as a Public Priority

To paraphrase a noted saying, "rail transportation of dangerous goods must not only be safe, it must be seen to be safe". The public wants to be assured that all that can be done to make the system as safe as possible is in fact being done. They want to know that safety is a top priority and that quick, decisive action — erring on the side of safety — will be taken. And they want a visible and tangible expression of this commitment.

It is important that the Minister of Transport emphasize this commitment on a consistent and continuing basis, and be seen to do so as well. It is also important that this commitment be tangibly expressed though organizational changes stressing safety, through the allocation of resources to safety activities, through corrective action to overcome substantiated deficiencies, and through a continuing effort to achieve safety excellence.

Examples of such efforts were seen in the quick and decisive action following the unfortunate collision at Hinton, Alberta, and actions taken by recent Ministers of Transport to promote safety. As transportation deregulation proceeds, public concerns about safety will increase; definite, proactive steps must be taken to ensure a safe and efficient railway system.

We recommend therefore that:

- **The Minister of Transport, as the National Transportation Safety Manager, be fully committed to ensuring the safe operation of Canada's rail system and that this commitment be publicly visible.**

At the same time, the railways themselves must make a similar commitment to put safety first. When we visited Houston, we learned first hand that such a commitment can bring dramatic results.

Until recently, Houston's Port Terminal Railway had one of the worst railroad safety records in the USA. In fact, it was about to be closed down by the Federal Railroad Administration. In a last effort to rescue the operation, the owners appointed a new General Manager who brought a new set of priorities. For the new manager, safety of the community and his employees came first. After safety came efficiency for the customer, and only then came productivity for the owners.

Today, just a few years later, the Port Terminal Railroad is one of the safest railroads in the USA; it is generating profits; and it is welcomed in Houston as a responsible corporate citizen.

We recognize that the Port Terminal Railroad is a small operation compared to the Canadian National and the Canadian Pacific. Nevertheless, we feel that it is an impressive example of the difference a publicly visible commitment to safety can make.

Our railway representatives on the Task Force constantly reminded us that safety is a top priority for both Canadian National and Canadian Pacific. They also pointed to concrete proof of their commitment in this regard. We acknowledge this commitment and believe it truly exists. But while this safety commitment may be clearly understood within the railways, it has not been clearly enunciated to the public. As a result, the general public lacks the assurance that this commitment exists.

We believe it is most necessary to ensure that safety be made a top priority by all charged with the safe operation of Canada's railways and that tangible and visible evidence of this priority be given, on a constant and continuing basis. When transporting dangerous goods, safety must be given top priority; in a situation of competing interests (i.e. safety versus time or dollars), that the decision must always be on the side of safety.

We recommend therefore that:

- **Safety be assigned top priority in the transportation of dangerous commodities and that the promotion of safety be publicly tangible, visible, and paramount.**

2.1.D The Need for National Safety Targets

One way to express a commitment to safety would be to set National Safety Targets for the rail system. Our consultants examined this issue in the international context, and we debated the concept vigorously amongst ourselves. We came to the conclusion that definitive statements, in terms of "acceptable" death or injury levels, were not workable.

A definitive target such as 'only so many deaths will occur this year' is an open invitation to unfair criticism, and perhaps is doomed to failure from the start. Targets which are unrealistic and can not be achieved are also counter-productive.

However, some mechanism can and should be developed that will demonstrate commitment, set an incentive towards safety improvement, and establish accountability. The railways themselves place great emphasis on safety; this component is part of the career and appraisal process for all their managers, and quarterly reports to their Boards of Directors on safety are mandatory.

Through the co-ordinated efforts of all levels of government, it was possible to set annual targets for reducing road traffic fatalities by a certain percent. This kind of statement, developed in conjunction with railroad management to ensure achievability, would be a useful mechanism, provided there is an effective way of measuring and monitoring performance to determine if such goals are in fact being achieved.

We recommend therefore that:

- **National Safety Targets, developed in conjunction with the railways, and expressed in percentage terms (i.e. reduce rail accidents by X% a year), be established, promoted and monitored by the Minister of Transport and that an accounting of the progress made towards this objective be given to the public from time to time.**

It is our further recommendation that:

- **The Minister of Transport, in establishing these safety objectives, place before the public the Canadian Railway Safety record compared with that of other jurisdictions and modes of transportation, so that an accurate and fair judging can be made.**

In this way the public will have the information needed to judge the safety of the system and public confidence will be improved.

2.1.E Separation of Regulatory Functions

In Canada the regulation setting, monitoring, inspection, and accident investigation functions have all been placed in one organization.

Although the Canadian rail safety record is good, we find that the lines between the various monitoring, regulatory and operating functions are blurred and that some change is needed to ensure an effective and dynamic regulatory system. We commend the Minister of Transport for actions taken in this regard with the introduction of the new Railway Safety Act and other proposed legislation.

In the British regulatory system the British Rail Inspectorate has been constituted as an independent inspection and accident investigation function since the 1840s. By being independent, and by conducting its investigations in an objective, impartial, factual and fully open manner, public confidence in its work is of a high order. The railway system (British Rail) operates safely with, for all intents and purposes, full autonomy, establishing its own rules and operational procedures while being subject to the Inspectorate's independent and impartial overview.

We are not suggesting that what is good in another country is automatically good for Canada. But we do feel that safety regulation and regulatory processes must be clearly delineated and that the public must have confidence in the process. In this regard, we commend the recent legislative actions taken to move the safety regulatory functions to Transport Canada, and the economic overview function to the new National Transportation Agency. Our consultants, after examining the world scene, also endorse these actions, to which we give our fullest support and encouragement.

We would however issue the following caution. The present legislation establishing the National Transportation Agency gives that Agency all the inspection and accident investigation duties of its predecessor, the Railway Transport Committee, until such time as the companion pieces of legislation - the Railway Safety Act, and the legislation establishing the Accident Investigation Board-are enacted. These must be enacted with all dispatch. To allow these pieces of legislation to lapse, or to be delayed unduly, will create a negative impression and undermine public confidence.

We recommend therefore that:

- **The legislation required to complete the separation of regulatory, safety inspection and accident investigation functions concerning the railways be given utmost priority.**

2.1.F The Need for a Centralized, Multi-modal

An up-to-date and accurate data base is needed when determining the need for a regulation or monitoring the effectiveness of rules and procedures.

Practically at every turn, we had great difficulty in getting sufficient data to carry out our own analysis. This situation is not unique to Canada nor unique to the rail mode of transportation. In fact, of all the surface modes, statistical data on the rail system appears to be one of the most complete.

The U.S. Office of Technology Assessment estimates an underreporting of accident and transportation information in the U.S. in the order of magnitude two to ten times, depending on the mode. While we did not undertake a similar study, we believe that, with the more centralized regulatory control in Canada and only two major railways, the railway data compiled in this country is of a fairly comprehensive nature.

However, data specific to the haulage of dangerous goods is greatly lacking; there are inconsistencies between data collected by different Agencies; and much of the data in the system is out of date. In part, this has arisen because the legislative mandate to regulate the railways in Canada rested with one Agency, the Railway Transport Committee, while the authority to manage the transportation of dangerous goods rests with another organization, the Dangerous Goods Directorate of Transport Canada.

Assessments of the danger involved in transporting a product should rest with just one competent organization, and all other Agencies and organizations should be compelled to accept these assessments — in the form of dangerous goods classifications, designations and reporting criteria — without question. A comprehensive, current and central data base capturing the necessary flow and accident data on the multimodal transportation of dangerous goods in Canada would help identify accident patterns and detect contributing factors.

In addition, a comprehensive and timely review of the Dangerous Goods listings would ensure that they are constantly up-to-date and accurate. A situation where new and unevaluated products are transported through densely populated areas without being first classified as to their potential danger is unacceptable.

We recommend therefore that:

- **A comprehensive, ongoing review of dangerous products designation and classification be undertaken;**
- **Transport Canada's Dangerous Goods Directorate be the only agency charged with compiling and promulgating the master classification listing (including special commodity designations) of all dangerous goods offered for transport; and**
- **Transport Canada's Dangerous Goods Directorate be given sole responsibility to establish accident and incident reporting criteria in conjunction with user agencies.**

There is also a need for a comprehensive, current and central data base capturing the necessary flow and accident data on the multi-modal transportation of dangerous goods in Canada.

The regulatory Agencies in the States have a data base comprising some 700 accident category data elements, while our Regulator's data base contains about 70 elements. Of course, 700 data elements are not necessarily helpful if the data is incomplete and inaccurate. In fact, U.S. regulatory officers indicated that 700 data elements may be too many. As more data elements are used, more effective mechanisms are needed to gather the required data and keep it up to date.

Officials with the U.S. Federal Railroad Administration, the U.S. National Transportation Safety Board, and the U.S. Research and Special Projects Administration all endorsed the concept of a common, co-ordinated North American data base containing pertinent and useful information. We support this concept, provided that the data gathered is made available to others — such as the Provinces and Municipalities — for their own specific transportation needs.

To explain the value of a common North American data base, we must first explain how the railroad system operates in North America. Within a 100 car train there can be cars of many ages; cars carrying different products with different weights and centres of gravity; full cars; empty cars; cars carrying fluids which slosh around; cars carrying solids which are bulky and heavy; cars owned by different suppliers/manufacturers; cars from different countries (United States and Mexico); cars in pristine condition; and cars which have undergone repairs. Together, or individually, these cars may travel all within Canada or may move back and forth across the Canada/United States border.

A common North American data base would indicate how, how much, when and what goods are flowing, in what type of container, and in what condition of tank or freight car. All this information would be meaningful to the Regulator and the carrier. More specifically, detailed knowledge is necessary on the causes of accidents and on the trends which may lead to an accident. Such trends would aid in taking preventative measures in advance and thus averting a catastrophe ahead of time. Public safety would be better served if such a centralized data base was established and maintained by the Regulator of the country involved.

We recommend therefore that:

- **A centralized data base on the transportation of dangerous goods containing similar data elements between Canada and the United States, and maintained by each country's respective Regulator, with accessibility rights of others, be established.**

2.1.G A Joint Canada/USA Commission to Establish Common Cross Border Standards

The railway representatives on the Task Force have stressed the importance of recognizing that Canada's rail system is part of a larger North American system. While it is clear that Canada's system does operate in a continental context, it is less clear if this North American system is really treated as one system, in a formal sense, at governmental levels. We found no formal mechanisms in place to support such a view.

With respect to rail traffic between the United States and Canada, we heard several concerns expressed about maintenance standards for tank cars, since no formal governmental mechanism exists between Canada and the USA to monitor and control such standards. We also heard that deregulation may have a negative impact on this aspect of Canada-US rail traffic.

Over the years, the Canadian and United States rail systems have developed in tandem, thanks to the professionalism of the railways and the Association of American Railroads. This has occurred even though there has not been any public safety requirement to do so. The Association of American Railroads has been a dominant influence in establishing common operating and maintenance standards within North America, and its work forms the basis for most of the Canadian and US regulations in existence today. The rail companies and the Association of American Railroads deserve much credit for their accomplishments.

However, it is the Regulator(s) to whom the public looks and it is the Regulator(s) who will ultimately be held accountable should deficiencies in public safety develop. It is necessary therefore for the Regulator to become responsible for ensuring that minimum common standards be established for this cross-border traffic.

Such formal mechanisms already exist for rail traffic between European Common Market countries, where each country is committed to maintaining agreed minimum standards. The fact that most rail companies in Europe are nationalized, with strong links to their national governments, may have facilitated the development of such standards. But the fact remains that a free rail flow system, operating within a formal mechanism, has been achieved in Europe — where there are many more countries than in North America.

The Canadian Pacific Railway and the Canadian National Railways form part of a Canadian system, but clearly operate within a North American context. A minimum common standard of condition, maintenance and repair is needed to facilitate the international flow of rail cars. Furthermore, we need a formal regulatory mechanism to ensure that this minimum standard is adequate and properly maintained, and that work to improve public safety through enhanced standards is undertaken.

The minimum standards now established by the Association of American Railroads can be used as a starting point, and the Association should continue to play a major role in the further development of these standards. However, we feel that the issue of public safety should not be left to informal arrangements. It is important that those in authority be seen to be fully committed to protecting the life and health of their constituents.

We recommend therefore that:

■ A joint Canada/USA Rail Commission be established to ensure the formal communication necessary to facilitate uniform safety standards governing the cross-border flow of rail cars between Canada and the USA, and that this Joint Commission be mandated to improve standards, thus improving safety.

Furthermore, we propose that:

■ Representation on this Commission be made up of five ersons - one each representing the Canadian and USA Regulators; one each representing the American railroads (AAR) and the Canadian railways (RAC); and one neutral chairperson.

2.1.H Establishment of a Permanent Advisory Council on the Rail Transportation of Dangerous Goods

Today large volumes of hazardous products are manufactured, transported and distributed in close proximity to a population that has little detailed knowledge of the risks involved, but is exposed to the consequences of a dangerous goods accident.

There are examples in the Greater Toronto Area where significant rail transportation infrastructures were built in outlying areas, only to be completely surrounded a few decades later by residential development. Similar developments have occurred in other modes of transport. Indeed, it has happened at static sites (i.e. factories and plants) as well as along transportation corridors and installations.

Clearly, the risk to the public increases as the distance between it and a potential dangerous goods accident decreases. Recognizing that there are extraordinary market pressures, inadequate legislative mechanisms, and an inadequate data base on dangerous goods, representatives of all interested parties should meet on a regular basis to discuss the best course of action regarding the safe transportation of dangerous goods.

It is not our intention to suggest what topics would be appropriate for such an Advisory Council to discuss. The topic of the safe transportation of dangerous goods, however, clearly needs to be discussed, and legislators need advice on actions to be taken. An Advisory Council representing all interested parties should perform these functions.

An Advisory Council on the Transportation of Dangerous Goods already exists to advise the Minister of Transport in this regard. This Advisory Council should be given prominence and made permanent, to provide a stable focal point for Ministerial advice. In addition, the general public should be significantly represented on this Advisory Council, since it will be the general public, in all likelihood, who will have to bear the consequences of any serious accidents in this area.

We therefore recommend that:

- **An Advisory Council, reporting to the Minister of Transport, on the Rail Transportation of Dangerous Goods be made permanent and be so constituted in its membership as to fully represent all interested parties, including, to a significant degree, the general public.**

The proposed Bill C105 (The Railway Safety Act) makes provision for a Railway Safety Consultative Committee dealing with any matter affecting safe railway operations. If the above recommended Advisory Council on the Rail Transportation of Dangerous Goods should overlap the Consultative

Committee, it could give rise to contradictory or confusing advice.

We therefore further recommend that:

- **The Advisory Council on the Rail Transportation of Dangerous Goods be required to work closely with the Consultative Committee proposed in the new Railway Safety Act (Bill C105).**

2.1.1 Improving the Regulatory Process

So far we have concentrated on the organization, infrastructure and database requirements necessary to promote and demonstrate a commitment to public safety. These, however, would have no lasting value if the results did not contribute to reduced risk and enhanced public safety.

We examined the regulatory process in place during our mandate. While we recognize that legislative changes are being undertaken, we wish to make the following observations and recommendations.

Regulation by Performance Standards versus Specifications

The rail industry is extremely overburdened with detailed regulations, on everything from the weight of the bell on locomotives to the positioning of lamps and tables in the engine cab. But the underlying reasons for these regulations are not made clear. This omission has created an environment where the Regulator has, in fact, become the operator of the railways rather than the organization to oversee, monitor, and establish national transportation safety policy.

The Regulator dictates the specifications on all matters for the railways. By so doing, it has created a stagnating and overburdened environment which permeates all aspects of the railway industry, from management/labour relationships and training to revenue viability and technological advancements.

Throughout our investigations, no one suggested we should get rid of the Regulator. Quite the contrary. The need for a Regulator who is impartial, objective and committed to the public good is fully recognized. However, regulations issued by the Regulator should be practical, effective and efficient, and the process to change these regulations should be streamlined and more responsive.

Regulations should also allow for technological innovation. At the National Research Council in Ottawa, we witnessed the superior safety qualities of the plastic jerry can versus the traditional metal one; the plastic container tended to melt in a fire, so its contents tended to burn — rather than explode. Yet, despite this evidence, changing the railway regulations to allow plastic containers continues to be a Herculean task.

Our consultants, in examining procedures in other jurisdictions, conclude that it is not so much what one regulates as how one regulates. They also point out that regulations must fit the society for which they were intended; regulations suited to Australia, for example, may not be automatically suitable for Canada or vice versa.

The Regulator needs to establish safety objectives, and then formulate performance standards to achieve those objectives — rather than detailed specifications. Performance standards allow for creativity and flexibility which, in turn, can benefit public safety.

Recent legislative thrusts are geared towards these performance-type regulations. While there will always be a need for some detailed specifications, we fully support performance standards as a more effective means of regulation, requiring the Regulator to spell out exactly what the objectives mean and what is expected in terms of performance.

Co-ordinated Regulatory Research and Development

The Regulator must have the capability to assess the value of proposals brought forward by the industry or the public at large. Such a capability depends on research and development.

We visited the National Research Council facilities in Ottawa; the Association of American Railroads research test site in Pueblo, Colorado; the Transportation Development Centre in Montreal; and the Research and Special Projects Administration facilities in Washington, DC and Boston, Mass. We also held discussions with British Rail Research personnel, visited the workings of the Canadian National Railways' laboratories in Montreal, and witnessed Canadian Pacific Railway field testing of the Advanced Train Control System in Calgary, Alberta.

We were immensely impressed with the amount of research and development going on. But we were dismayed at the under-utilization of government laboratories, and the lack of a co-ordinated research capability on the part of the Regulator.

Of course, there is often a thin line between research and development for productivity gains, and research and development to improve safety. Our concern is solely with the latter. The Regulator, however, needs to be fully aware of all current research and development, and to identify that which is relevant to safety. This capability is needed both for proposal evaluations and to encourage the promotion of safety.

We strongly recommend therefore that:

- **The Regulator have the capability of understanding, using, co-ordinating and, where necessary, undertaking Safety Research and Development as an aid to promoting public safety.**

2.1.J The Need for An Independent Safety Audit Function

As previously stated, the theme of public safety dominated our investigations from start to finish. Whether we were discussing relocation, rerouting, improved monitoring or inspections, the message we kept hearing was the same: "Make the system safe, and assure us — through concrete actions — that all reasonable steps are being taken to achieve this end".

We heard frequent criticism of the railways and their apparent disregard for the anxieties of the public living along their rights-of-way. In fact, this criticism is unfounded, and the railways do consider safety to be an extremely important part of their job. But there is an appalling lack of knowledge in the general public about what passes along the rail lines, and a reluctance on the part of the railways to communicate and work with the communities they affect. The result is an unhealthy skepticism between the public and the industry. We are encouraged to believe that the railways now recognize this problem and are taking steps to resolve it.

Our public perception survey reinforces the public's need for assurance. Seventy-six per cent of respondents said they "could live with the existing system" if they were convinced that "measures to reduce the risks from the transport of dangerous goods by rail are of top quality". Submissions sent to the Task Force reflected a similar concern, emphasizing the need for better monitoring and inspection, properly monitored and enforced speed regulations, and the highest quality maintenance standards.

There is a pressing need for an ongoing operational Safety Audit, independent of both the Regulator and the Accident Investigators. This audit function would not replace those of the Regulator and the Accident Investigator. Quite the contrary: the audit findings would be provided to both these groups for their own respective action. But the public in the Greater Toronto Area needs to be assured of the independence and integrity of this audit, and its findings should be subject to public scrutiny.

This independent operational audit must be comprehensive, and all-inclusive, encompassing all parties involved in the transportation system — from the shipper, through the carrier, to the customer. (The railways themselves own and operate relatively few tank cars. The vast majority belong to, or are leased by, the shipper. It is the shipper and customer who assumes the responsibility for properly loading and unloading the product involved.)

The audit must also cover all aspects of the system, from the subgrade through the infrastructure to the human and technological components of the system, including the management of such components.

The Auditor must have the ability and authority to judge the effectiveness of those creating and promulgating regulations, as well as those to whom the regulations apply. It is only through this type of audit, focused on public safety, that public confidence will be sustained.

We therefore strongly recommend that:

- **An Independent Operational Safety Audit function be established, with a broad mandate for safety of transportation involving the rail system, the findings of which must be open to full public scrutiny;**
- **The Independent Operational Safety Auditor report directly to the Minister of Transport, in the same way as an internal auditor;**
- **Findings of the Independent Operational Safety Auditor be made available to both the regulatory and accident investigation functions, as well as to any railway, shipper, receiver or other parties audited, for any subsequent action; and**
- **Steps be taken to ensure that the duties of the Operational Safety Auditor remain, and be seen to remain, separate and distinct from those of the Regulator and that this audit role not be perceived as an encroachment on the regulatory function.**

2.1.K Other Issues

Railway Regulations to be issued by Municipalities

During our briefings to the various Regions and Municipalities in the Greater Toronto Area, we were asked to examine and comment on whether the authority to issue regulations affecting the Railways, in selected areas such as speed requirements, could be given to the Municipalities.

Such an approach has been used in the U.S., and there is much to be said for it. Municipalities represent the level of government closest to the general population, and it is primarily the Municipalities that must deal with the consequences of rail accidents. Nevertheless we are unable to support such a concept at this time.

Braking and accelerating can generate substantial forces within a train, because of the inevitable slack between cars. This braking and accelerating action takes time to transmit itself throughout the whole train, sometimes up to 5 minutes depending on the train's length. These in-train forces can cause accidents, and must be minimized. Changing speeds from one Municipality to another could accentuate the constant changing of in-train forces, and thus the possibility of an accident.

It is also possible that Municipalities would impose speed, hours of operation or other restrictions for local or non-safety related reasons only, without really examining the impacts on railway operations or on safety as a whole.

Given the need, from a public safety point of view, to provide as smooth a transition through a community as possible, and recognizing that the railway operation is an economic continuum from one end of the country to another, all but one member of the Task Force cannot support the concept of fragmented railway authority for setting regulations.

(The one member minority position maintains that there may be extenuating circumstances where a municipality, such as Metro Toronto, should have some means of protecting its citizens in emergency circumstances where the regulatory authority is slow to respond. Considering that Metro Toronto is the commercial hub of the entire country with a population fully ten percent of the national total, this minority position finds it unacceptable to Metro citizens that their desire for speed restraint on dangerous goods rail traffic can be frustrated by a lack of political will in the federal administration or a lack of decision-making by an indifferent Regulator. This minority position further contends that many cities in the United States have achieved authority to impose speed restraint which has brought relief from rail accidents. That same kind of responsible authority should be available to Canadian cities which have demonstrated critical need.)

Cabooseless Trains

We did not consider the future of cabooseless train operations in the haulage of dangerous goods, since this issue was addressed by the Railway Transport Committee of the Canadian Transport Commission. We note, however, the comment of one Task Force member that there are good reasons to conclude that a trained railway employee at the rear of a long, heavy train carrying dangerous goods through the narrow Metro Toronto corridor would provide added security, and help prevent rail accidents.

Speeding Up Accident Reports

We heard complaints that investigations of accidents by the Railway Transport Committee under Section 226 of the Railway Act have been very slow, with a good deal of time lost in completing and publicizing the investigation results. One example is the Metro Toronto derailment at Don Mills on July 14, 1987, involving 31 cars and three locomotives. Results of the investigation are anxiously awaited by the community involved, yet 11 months later the report is still not completed.

We are advised that under the new National Transportation Agency, investigation reports will be ordered completed in 60 days, and if completion is not possible in 60 days a progress report will be filed by the investigating officer and made public. We believe this should help reduce anxieties.

We therefore recommend that:

- **The Federal Regulator ensure that investigations into dangerous goods accidents are initiated promptly; that the 60-day deadline for issuance of the results is met, and that follow-up action on deficiencies or faults shown in the investigator's report is launched without delay.**

Private Sidings - A Responsibility Gap

A 'legal' inspection and monitoring gap exists concerning railway cars resting on private (i.e. Company) sidings. The Railway Act provides that the Railway Transport Committee inspectors have the authority to inspect and monitor all federally regulated railway cars offered for transport, from the start to the finish of the transportation cycle. But tank cars can be, and sometimes are, used as storage containers while resting on private sidings, and thus would not fall under such inspections.

The problem is one of legal definitions. The Boiler and Pressure Vessels Act of Ontario sets out various rules and conditions regulating boilers and storage tanks, as well as standards established by the American Society of Mechanical Engineers (ASME). Railway tank cars, however, are manufactured and maintained under the Association of American

Railroad (AAR) standards. While these are similar and often exceed the ASME standards they are not — legally — ASME standards.

As a result, a tank car which sits on a private siding for more than 48 hours legally becomes a storage tank, but does not legally conform to the Boiler and Pressure Vessels Act of Ontario. Furthermore, Railway Transport Committee inspectors do not have the legal authority to inspect these tank cars. Should a tank car be kept moving on the private siding, then legally also it is not a storage tank - thereby not subject to the Boiler and Pressure Vessels inspectors' scrutiny.

Should this same tank car not be offered for transport on federally-regulated railways, then it is not subject to the Railway Transport Committee inspectors' scrutiny - hence the responsibility gap.

The Railway Transport Committee inspectors have been exercising an unofficial authority of inspecting these vehicles, whenever and wherever they find them. The simplest solution is to define a tank car or freight car as a vehicle always being offered for transport and to empower the Railway Transport Committee inspectors to include these vehicles within their official jurisdiction.

We recommend therefore that:

- **The Railway Safety Act be amended to allow the Regulator to inspect all federally regulated railway cars, especially tank cars regardless of their status.**

Posting of Bonds by the Railways

We were asked to comment on whether the railways should be required to post Performance Bonds in the case of damage, injury or death caused by railway accidents. This issue was also raised in our public hearings when the Annex Residents' Association suggested that the railways should be required to carry insurance coverage.

When examining this question we considered the railways' safety record; the fact that other modes of transport are not required to carry such insurance or post such bonds; the economic cost this would impose on the railways; and the past actions of these companies in the case of accidents. We also determined that federally regulated railways are subject to the requirements of the Ontario Spills Bill.

We believe that the concept of 'self' insuring is valid and is exercised by many organizations including governments at all levels. Furthermore, nothing in the railways past actions suggest that they would not act responsibly and legally, or would not have the resources to cover claims in the event of an accident. We therefore do not support the concept of requiring the railways to post Performance Bonds or to carry insurance.

Communications and Community Interface

Public Safety is, in our view, a combination of reality and perception. Something may be safe in fact but, if it is perceived to cause harm, then in the minds of the general public it is unsafe.

One objective of our public perception survey was to determine the perspective of those living in the Greater Toronto Area on the nature of dangerous goods. We wanted to know how the public perceived the need and importance of dangerous goods to the Greater Toronto Area; the means by which they were transported; and whether the transport by rail of these products was considered safe, or as safe as is reasonably possible. Except for a 25% minority, respondents were not very knowledgeable about railway operations or about dangerous goods.

We have already noted a lack of public trust in statements made or actions taken by the railways, in spite of the truth of those statements and the good intentions behind the actions. There appears to be a major gap in understanding and acceptance between the railways and certain parts of the public. This gap has no doubt arisen because the railways deal with problems in an impersonal, technological way, while the public deals with issues from a more emotional perspective.

We encountered several concrete examples during our deliberations which reinforce our conviction that better communications is not only desirable, but invaluable. In several instances the Task Force referred requests for information directly to one of the railways. When the railway provided the requested information in a helpful way, or initiated a simple remedial action, there was a direct and dramatic change in attitude on behalf of the citizens involved.

We have also noted the excellent example of a good railway/community relationships in Houston, Texas. In this case, the Port Terminal Railway established a full-time Public Coordinator position, and the Mayor established a Coordinating Committee, with special subcommittees which are in communication with over 200 citizen associations. These initiatives were taken because both sides recognize that the railway is a part of the community; it can adversely affect the community by allowing unsafe practices; but it provides an essential transportation service to the community. The result is a high level of cooperation between all parties; criticism and complaint have for the most part been replaced by discussion and understanding.

A similar approach should be considered in the Greater Toronto Area, as part of the cost of doing business. The needs in the Greater Toronto Area may be different from those in Houston, and specific arrangements may have to be adjusted over time. But the enduring ingredient — an element of mutual trust — is essential in the Greater Toronto Area.

This continual interface between the railways and the Municipalities could cover a number of areas, such as long range operational plans, railway crossing problems, and citizens' concerns. An example of an initiative which could yield early public safety benefits would be a mutual approach to the problem of trespassing on railway property. Railway and Municipal staff involved with security matters could complement each other in a joint program of this sort.

We recommend therefore that:

- **The railways pay more attention to community information exchange and cooperation in order to provide greater assurance and appoint, as a normal business expense, a coordinator who would interface with municipalities and residents' Associations on an ongoing basis;**
- **Regional Municipalities within the Greater Toronto Area individually or collectively appoint a coordinator(s), at a senior level, who would interface with the railways and community groups;**
- **The railways, the Province of Ontario and Municipalities/Regions establish, at a senior level, a formal liaison committee mechanism through which issues can be discussed and resolved; and**
- **Governments, at all levels, and the railways promote and encourage an increased level of knowledge and communication within the general public in the area of the transportation of dangerous goods by rail.**

2.1.L Conclusions

Public Safety must start at the top, it must be effective, and it must be seen to be effective. National Safety Targets aimed at an improved and safer environment, carried out by properly separated regulatory organizations, supported by an adequate multi-modal dangerous good database and a co-ordinated safety Research and Development capability will go a long way towards improving public safety across Canada, and in the Greater Toronto Area.

Regulation through performance standards, monitored by both the Regulator and an independent operational safety auditor, will help to ensure the public that "everything that can be done to improve safety, is being done".

The railway industry discharges a great deal of its safety initiatives under the auspices of the Association of American Railroads. These initiatives include, in large measure, those areas that have been delegated by the Regulator (eg. tank car integrity). The Regulators of both governments are free to attend the Association's Tank Car Committee meetings but do not do so on a regular basis.

While a Memorandum of Understanding exists between the Canadian and U.S. governments, contact is intermittent and informal. For systems as closely associated as the Canadian and U.S. railway systems, we consider a more formal relationship to be necessary.

As a result of our contacts with community groups and individuals, we feel there is a great deal of improvement required in communication between the Railways and the public if confidence and understanding with respect to the safety of the rail system is to be achieved.

We firmly believe that by carrying out these changes in an environment of open communications, the barriers of mistrust will be lowered and the perception of public safety substantially improved.

3.0 The Analysis of Routing Alternatives

A Longer Term Option

3.1 Introduction

3.1.A General

A major part of our mandate was to determine if either rerouting or relocating rail services carrying dangerous goods in the Greater Toronto Area were feasible; and if so to determine the implications of such actions.

To fulfill this mandate, we set out to identify and compare alternative routes rather than provide the detailed design of any one particular route.

We reviewed alternatives from an engineering point of view, including environmental and community impacts. We also considered a number of other factors, such as the operational and economic impacts on the railways and on shippers, and the degree to which alternatives reduced the risk to the public. Of particular interest was the potential for shifting from railways to trucks that may result from rerouting or relocation.

Since the existing system is already presently in operation, we treated it as a viable option. Alternative routings were assessed against this existing system, with reference to operational requirements for transporting dangerous goods; the increase or decrease in risk to the public; the protection of rail rights-of-way from future encroachment; and, of course, the costs involved in constructing and operating on any alternative route.

3.1.B Alternative Routings and Operational Strategies

We began by identifying a range of options to study. We consulted libraries, Regional planning offices, and those of Ontario's Ministry of Transportation and Communications (now the Ministry of Transportation) to locate past studies, proposals or ideas. We contacted several consulting firms working on this topic in the Greater Toronto Area. We reviewed studies undertaken by the railways themselves. In addition, of course, we had our own expertise resident on the Task Force itself.

Based on this preliminary data, we put together six major 'corridor' options:

i) **The Lake Corridor option.** A completely new rail line would be built in Lake Ontario, at an appropriate distance offshore, to accommodate both Canadian Pacific's and Canadian National's dangerous goods 'through' traffic.

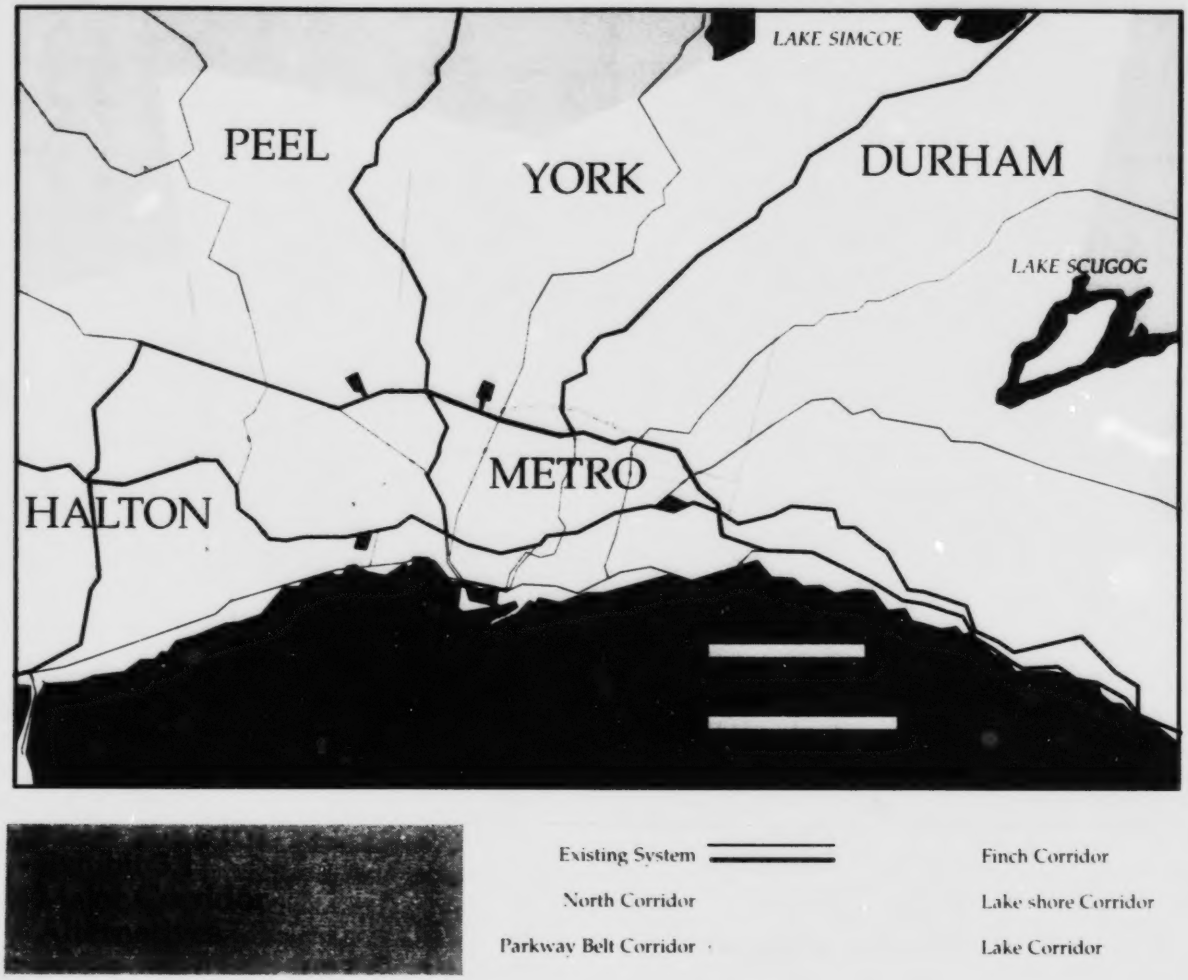
ii) **The Lakeshore Corridor option.** Both Canadian Pacific's and Canadian National's 'through' traffic would be rerouted to the existing Lakeshore line, presently running along the Lake Ontario waterfront.

iii) **The Existing System Corridor option.** Canadian Pacific's dangerous goods traffic would continue to move east-west through the middle of Halton and Peel Regions, mid-town Metropolitan Toronto, and southern Durham Region; Canadian National's dangerous goods traffic would continue to move through Halton and Peel Regions, southern York Region and southern Durham Region. Dangerous goods traffic to and from Western Canada would move north-south by Canadian Pacific's MacTier Subdivision and Canadian National's Bala Subdivision. ("Subdivision" is a segment of track.)

iv) **The Finch Hydro Corridor option.** Canadian Pacific's and Canadian National's 'through' dangerous goods traffic would be rerouted to a completely new rail line built in the east-west Ontario Hydro utility corridor running through the Region of Peel, just north of Mississauga and through Metropolitan Toronto on an alignment slightly north of Finch Avenue. This corridor is presently occupied by hydro towers.

v) **The Parkway Belt Corridor option.** Both Canadian Pacific's and Canadian National's dangerous goods 'through' traffic would be rerouted into the Parkway Belt in specific segments. This corridor was established as a transportation/utility right-of-way by the Ontario Provincial Government in the early 1960s on an east-west alignment immediately north of Mississauga and Metropolitan Toronto. This corridor is now occupied by hydro towers, underground utilities and the recently initiated Highway 407. This option would use some existing Canadian Pacific and Canadian National trackage but would require some new rail line as well.

vi) **The North Corridor option.** A completely new rail line would follow a more northerly alignment away from any population concentrations through the north of Halton and Peel Regions, through the middle of York Region, and then


LAKE SIMCOE
PEEL
YORK
DURHAM
LAKE SCUGOG
METRO
HALTON
Existing System
North Corridor
Parkway Belt Corridor
Finch Corridor
Lake shore Corridor
Lake Corridor

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either through the north or south of Durham Region depending on the sub-option chosen. This corridor runs north of major existing, and planned, urban development to the year 2011, and specific routings would be selected to avoid towns and built-up areas. It would be some 60 to 80 kilometres in length.

The above options are illustrated in Exhibit 3.1.

Our consultants provided a preliminary assessment of each 'corridor' and identified significant difficulties with three of these options:

- **Lake Corridor Option:** Extremely expensive; did not reduce risk to the population below that of the existing system; potential environmental hazard to Lake Ontario.
- **Lakeshore Corridor Option:** Increased the risk to the public due to the high density of daytime employment.

Corridor	**Population Exposed**	**Capital cost**	
A. Existing System			
CP Galt/North Toronto/ Belleville	●	○	Existing route
CN Halton/York	◐	○	Existing route
Alternative Corridors			
B. Parkway Belt	◔	◐	Some new construction required
C. Northern	○	●	Considerable length of new track
D. Finch Hydro	●	●	Power line reconstruction, many road crossings
E. Lakeshore	●	◔	Existing route
F. Lake	●	●	New construction

Exhibit 3.2
Initial Screening of
Corridor Alternatives

● *High Exposure or High Cost*
○ *Low Exposure or Low Cost*

■ **Finch Hydro Corridor Option:** Did not reduce the risk to the public below that of the existing system; expensive to relocate existing Hydro towers and construct a new line.

These options were dropped from further consideration. (Exhibit 3.2 illustrates this initial screening process.)

We were therefore left with the three following major options:

A. The Existing System Option

B. The Parkway Belt Corridor Option

C. The North Corridor Option

In order to understand the complexity of these options, we personally toured the three corridors and witnessed for ourselves the degree of urban development underway in the Greater Toronto Area, and the topographic difficulties to be overcome in constructing any new rail lines.

3.2 The Existing System Option

3.2.A Background

The existing system deserves careful consideration as an option for three reasons:

i) The system has operated efficiently, in general terms, has been well maintained and is servicing the community it was designed to serve;
ii) Alternative routes would be primarily for 'through' traffic only. The public strongly stated, and the Task Force agreed, that 'local' dangerous goods traffic should not be diverted to trucks as part of a relocation alternative; and
iii) Any alternative system would have to be compared to the existing system in terms of technology, costs, comparison of risk and operating efficiency.

The present system has been developing since 1855, when the main lines running along the Lakeshore to the east and west of Toronto first opened to traffic. These two lines are now known as the Oakville and Kingston Subdivisions of the Canadian National Railways. Canadian National's Halton, Bala and Newmarket Subdivisions, and Canadian Pacific's North Toronto, Belleville, Havelock, MacTier and Galt Subdivisions were opened by 1906.

The last of the current lines, Canadian National's York Subdivision, with an extension of the Halton Subdivision (to complete a northern route around the City of Toronto) opened in 1964. This initiative was taken by Canadian National to avoid the growing congestion in those parts of the City where the yards complementing their two main lines were located. It was also designed to link up with a pipeline coming in from Sarnia, Ontario. This relocation involved replacing those downtown yards with a major new classification yard, the McMillan Yard, located north of Metropolitan Toronto in the Town of Vaughan. An additional major intermodal yard west of Metropolitan Toronto, the Brampton Intermodal Terminal, followed soon after.

At the same time, Canadian Pacific also faced downtown congestion. It followed a less extensive restructuring plan, adding a major new classification yard at Agincourt, Scarborough while continuing to use its 'make-up' and intermodal yards at Obico and Lambton. Canadian Pacific has only recently taken initial steps toward a major new intermodal yard, on its MacTier Subdivision just south west of Kleinburg.

The railways' initiatives in the 1950s and 60s were designed to remove, to the extent practicable, their operations from the developed and developing areas of Greater Toronto. At that time, the land surrounding the York Subdivision, the eastern part of the Halton Subdivision, and both the Agincourt and MacMillan Yards was almost entirely undeveloped.

The explosive development northwards since that time has engulfed these areas in residential and industrial development. Because of this encroachment, incompatibilities of land use now exist in terms of noise, vibration and the concern for public safety.

3.2.B Condition of the Present System

The present railway system in the Greater Toronto Area is a well-maintained network which has operated well in the community. While we heard, from time to time, concerns from the public about the appearance of a bridge or poorly maintained fencing, both our own consultants and Railway Transport Committee inspectors state that the system is, in general, of high quality and in many ways close to 'state of the art' for North America. (We acknowledge that future rehabilitation may be expensive and have considered such costs when comparing rerouting options.)

Although, as previously stated, the existing system was already 'in place' and therefore had to be considered as a viable alternative, the other specific reasons mentioned above were significant enough, in our view, for the Task Force to consider it as an option.

3.2.C Traffic Flows - Present and Future

Both the railways and the chemical/petroleum industries predict that dangerous goods rail traffic volumes will decline over the next several years, and if any growth does take place it will be modest, localized, and too small to offset the declines. Based on the information they provided us, and in order to remain conservative in our estimates, we projected that dangerous goods traffic will remain as is to the year 2011. The traffic flowing on the existing system is shown in Exhibit 3.3.

3.3 The Parkway Belt and the North Corridors

We turn now to the other two major options - the Parkway Belt Corridor option and the North Corridor option.

Parkway Belt Option

The area now known as the Parkway Belt was originally set aside for the development of a high-capacity freeway, Highway 407, to meet the future needs of those growth areas to the north of Metropolitan Toronto. But in the 1960s, the Province took the Parkway Belt initiative to establish an urban separator and major utilities corridor. At first the south limit of this corridor was to be located where the Region of York adjoins Metro Toronto; but this was not feasible due to the rapid development already taking place in the area. The Province decided to use the Highway 407 right-of-way as the core of the Parkway Belt. The Belt was not originally intended to accommodate rail traffic.

Our Parkway Belt Corridor options involve some new rail tracks in the Regions of Peel, Halton and York, but otherwise use parts of the Canadian National's Halton and York Subdivisions, and the Canadian Pacific's Galt Subdivision.

North Corridor Option

The North Corridor would generally pass north of projected development to the year 2011. It would avoid populated areas, yet would lie south of the extremely rough, railway incompatible terrain north of the Georgetown, Caledon East and Oak Ridges areas. This option would use part of Canadian National's Halton Subdivision west of Toronto, new lines in the North on an east-west axis, and join up with the Canadian National's Kingston and the Canadian Pacific's

Exhibit 3.3
Summary of Dangerous Goods Flows By Rail

Annual Carloads - 1985

C.N. Traffic	**Local**	**% Total**	**Through**	**% Total**	**Total**	**% Total**	**% Through**
Dangerous Mixed Loads	13810	03.0	1692	00.3	15502	01.5	10.9%
D.C. Car Loads	3288	01.0	6425	01.2	9713	01.0	66.1%
S.D.C. Car Loads	1369	00.2	10770	02.0	12139	01.2	88.7%
All D.G. Car Loads	18467	03.9	18887	03.5	37354	03.7	50.6%
Non-dangerous Car Loads	280057	59.3	271752	50.5	551809	54.6	49.2%
Residue D.G. Tank Cars	4949	01.0	16372	03.0	21321	02.1	76.8%
Non-dangerous Residue Cars	158428	33.6	231465	43.0	399893	39.6	57.9%
Total Cars	**471901**	**100.0**	**538476**	**100.0**	**1010377**	**100.0**	53.3%
C.P. Traffic							
Dangerous Mixed Loads	9312	02.5	980	00.4	10292	01.7	9.5%
D.C. Car Loads	2594	00.7	9952	04.0	12546	02.0	79.3%
S.D.C. Car Loads	1165	00.3	5283	02.1	6448	01.0	81.9%
All D.G. Car Loads	13071	03.5	16215	06.5	29286	04.7	55.4%
Non-dangerous Car Loads	235793	62.9	185157	74.4	421950	67.7	44.1%
Residue D.G. Tank Cars	2574	00.7	13249	05.3	15823	02.5	83.7%
Non-dangerous Residue Cars	123150	32.9	33326	13.4	156476	25.1	21.3%
Total Cars	**374588**	**100.0**	**248947**	**100.0**	**623535**	**100.0**	39.9%
Total Traffic							
Dangerous Mixed Loads	23122	02.7	2672	00.3	25794	01.6	10.4%
D.C. Car Loads	5882	00.7	16377	02.1	22259	01.4	73.6%
S.D.C. Car Loads	2534	00.3	16053	02.0	18587	01.1	86.4%
All D.G. Car Loads	31538	03.6	35102	04.5	66640	04.1	52.7%
Non-dangerous Car Loads	515850	59.7	457909	58.2	973759	59.6	47.0%
Residue D.G. Tank Cars	7523	00.9	29521	03.7	37144	02.3	79.7%
Non-Residue Cars	291578	33.7	264791	33.6	556369	34.1	47.6%
Total Cars	**846489**	**100.0**	**787423**	**100.0**	**1633912**	**100.00**	48.2%

Belleville Subdivisions to the east. One additional sub-option would also use the right-of-way of part of the Canadian Pacific's Havelock Subdivision, to bypass the more populated areas of the Region of Durham.

Within these two main corridor options, there are several operational alternatives. These involve using different bypass routings; different amounts of trackage (i.e. two, three or four track systems); and simulating various volumes of traffic over the different configurations. The location of railway yards is also important, especially if and when traffic is shifted further to the North.

For all the operational alternatives, capital and operating costs were developed, and railway operational efficiencies, or restrictions, were recorded. Exhibit 3.4 describes the various routing alternatives and Exhibits 3.5 to 3.12 show these routes graphically.

3.4 Operational Strategies Not Considered

We received several submissions with requests ranging from stopping dangerous goods traffic entirely to transporting them by ship or by pipeline. We also received suggestions that dangerous goods should be transported at night only, or in dedicated trains carrying only a dangerous product(s) under strict conditions.

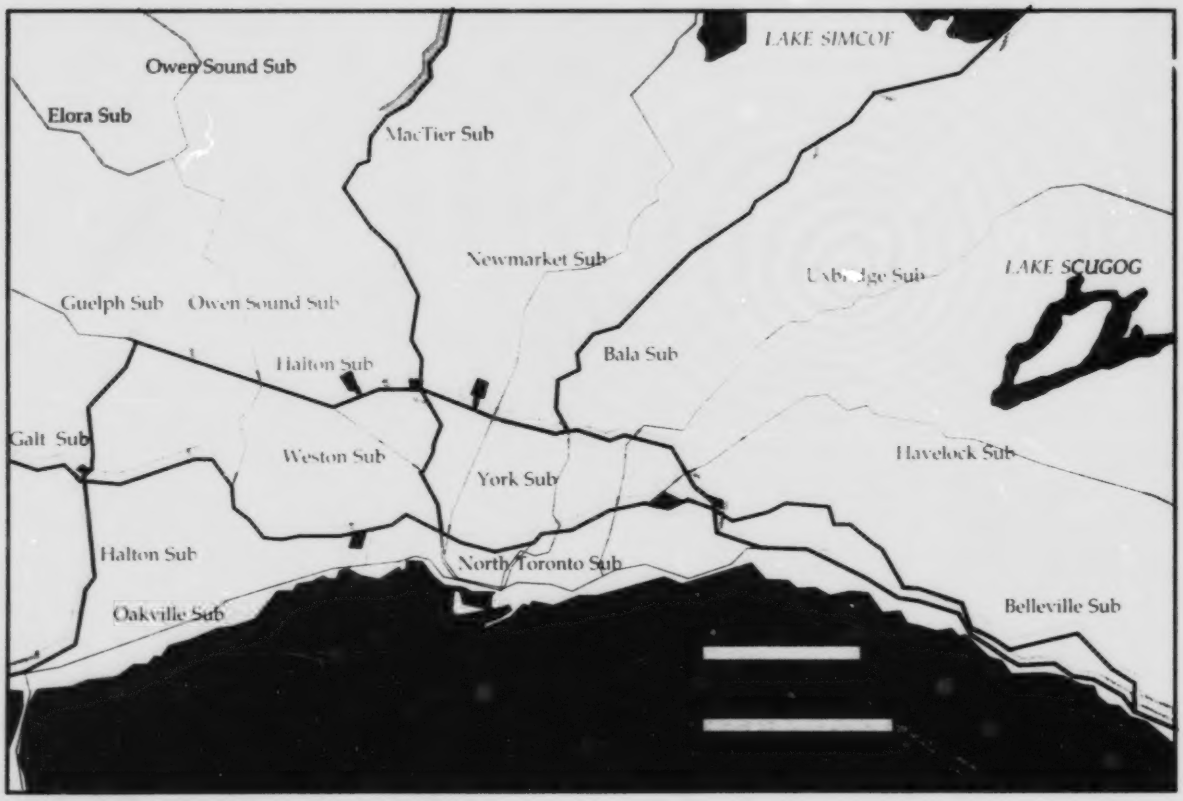
The 'dedicated' train proposal was roundly opposed by all communities, the railways and the Unions. A similar exercise had been undertaken by Canadian National several years previously and was found to be operationally disruptive. Such trains are also considered a more unsafe practice since they require an extensive amount of extra handling. The American system is able to overcome this extra handling problem solely because of the volume hauled in that country. In Canada, our volumes are not sufficient for dedicated trains to be economically viable.

The transportation of dangerous goods at night would create a schedule disruption for the railways. And, according to information from the United Kingdom, it would in fact increase the risk to public safety. In the event of an accident involving toxic gases, the calmer, night-time winds do not disperse the gases as quickly as day-time winds. This, along with the increased vunerability of a sleeping population, led us to discard this proposal as a viable option.

Exhibit 3.4 Rail System Alternatives

**Indicates the alternatives for which detailed risk were assessed.*

Alternative	Network	CN Traffic Routing	CP Traffic Routing
A1*	Existing	Existing	Existing
A2*	Existing with additional connections	Existing (A1)	Diversion of CP mainline DG trains to Halton/York Subs
B1A	Sub-route 'A' follows the CN York Subdivision Sub-route 'B' follows the Hwy. 407 Parkway Belt Corridor diverting (by passing) around Thornhill	Milton cut off for all through Halton Sub trains	Route B for mainline DG trains only, Agincourt Yard
B1B			
B2A*		Same as B1A or B1B	Route B for mainline DG trains, Agincourt Yard
B2B*			
B3A		Same as B1A or B1B	Route B for all mainline trains, new Woodbridge Yard
B3B			
C1*	Most northerly alignment	Mainline trains carrying DG's; set-off through DG cars at Vandorf & Cherry to avoid bringing them into MacMillan Yard	Route C1 for all mainline trains, new yard in Bolton area
C2	Same as C1	Route for all mainline trains, new yard in Vandorf Area	Same as C1
C3*	Most southerly alignment	Mainline trains carrying DG's; set-off through DG cars at Elgin and North Maple to avoid bringing them into MacMillan Yard	Route C2 for all mainline trains, new yard in Bolton area


LAKE SIMCOE
Owen Sound Sub
Elora Sub
MacTier Sub
Newmarket Sub
Uxbridge Sub
LAKE SCUGOG
Guelph Sub
Owen Sound Sub
Halton Sub
Bala Sub
Galt Sub
Weston Sub
York Sub
Havelock Sub
Halton Sub
North Toronto Sub
Oakville Sub
Belleville Sub

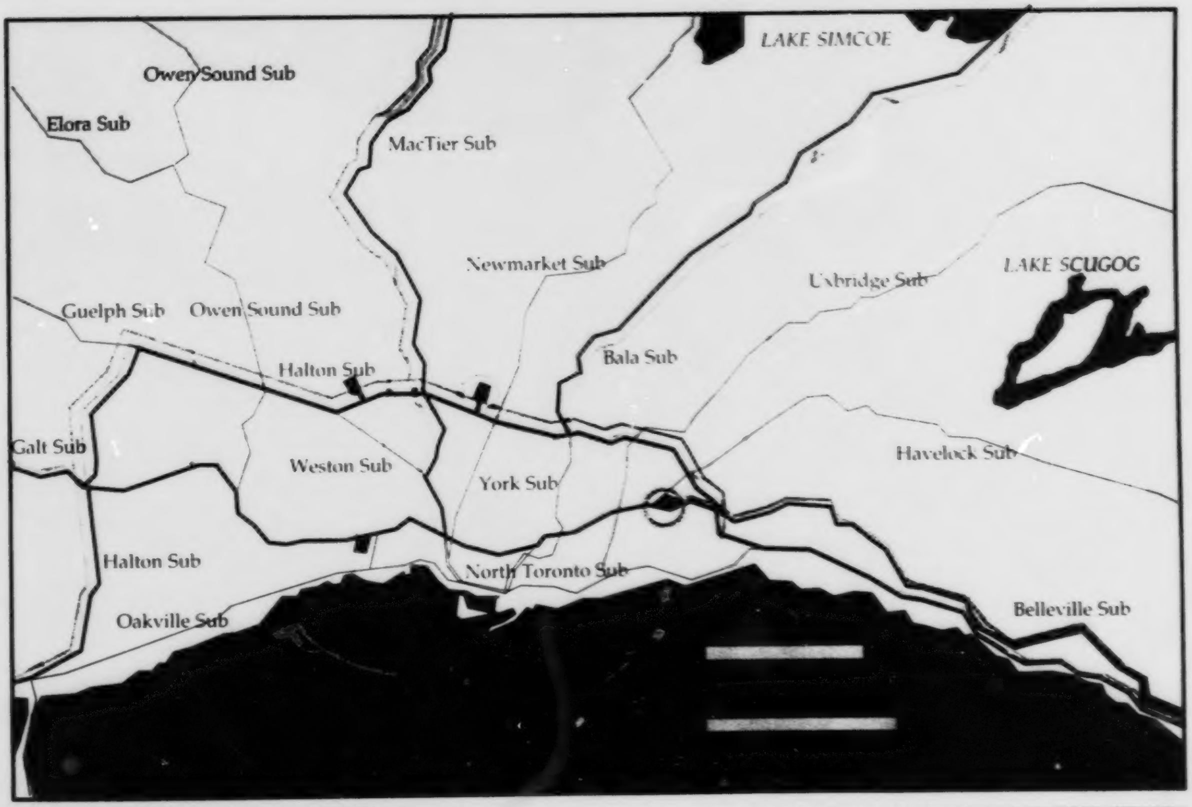
E[illegible] [illegible] A1 [illegible] System ([illegible] trains only)

CN DG Route and Yards

CN Non DG Route and Yards

CP DG Route and Yards

CP Non DG Route and Yards


LAKE SIMCOE
Owen Sound Sub
Elora Sub
MacTier Sub
Newmarket Sub
Uxbridge Sub
LAKE SCUGOG
Guelph Sub
Owen Sound Sub
Halton Sub
Bala Sub
Galt Sub
Weston Sub
York Sub
Havelock Sub
Halton Sub
North Toronto Sub
Oakville Sub
Belleville Sub
CN DG Route and Yards
CP DG Route and Yards
CN Non DG Route and Yards
CP Non DG Route and Yards

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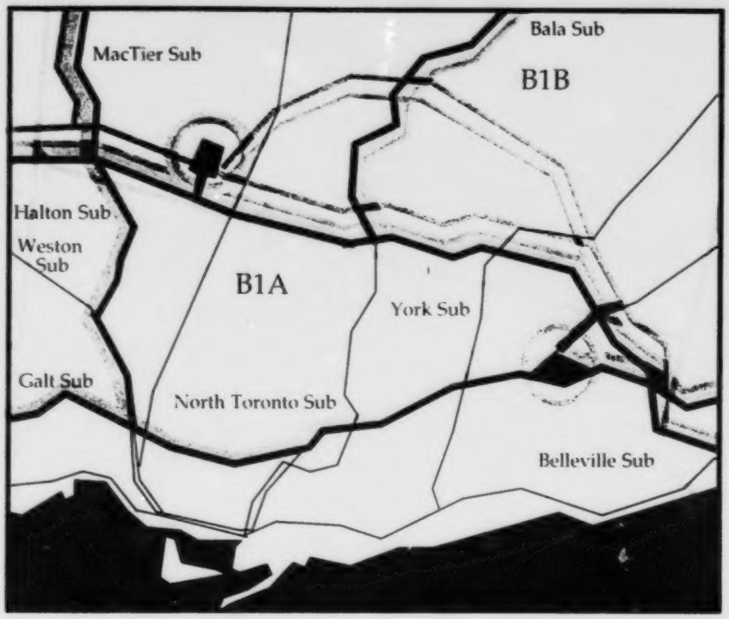
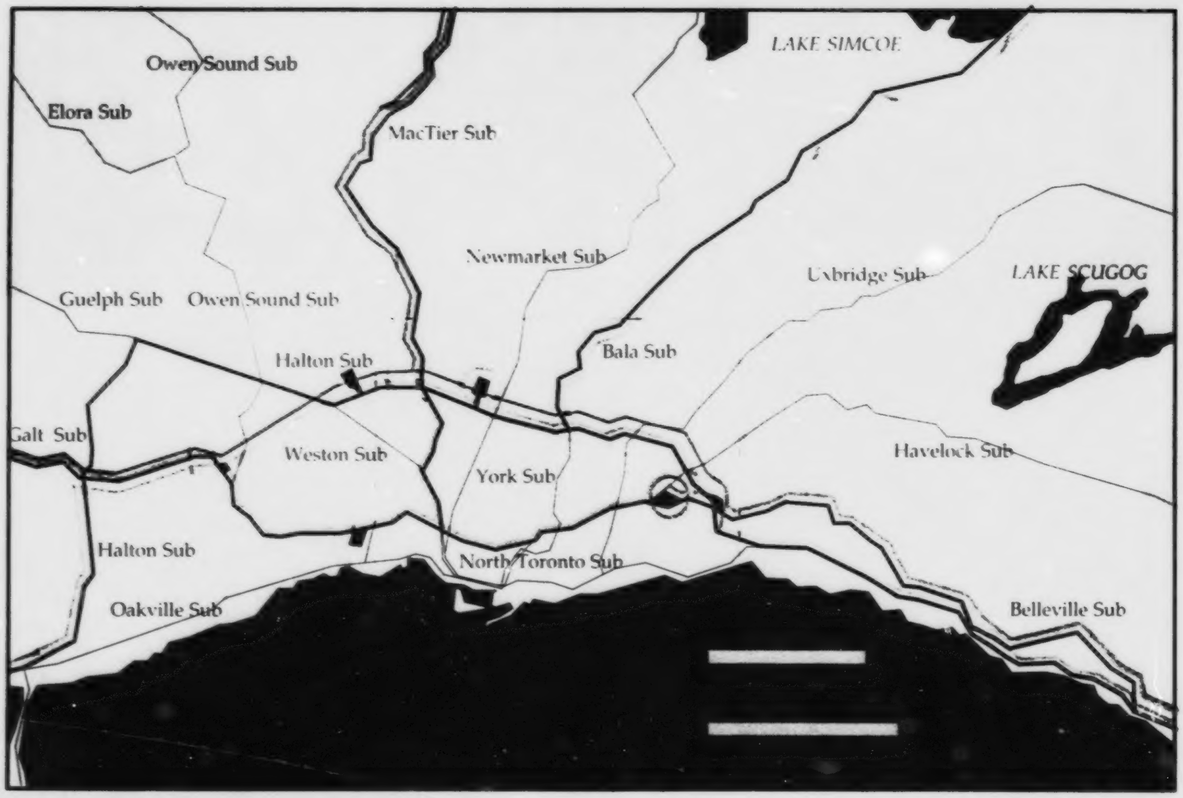
Detail showing the differences in the corridor options B1A and B1B


Bala Sub
MacTier Sub
B1B
Halton Sub
Weston Sub
B1A
York Sub
Galt Sub
North Toronto Sub
Belleville Sub


LAKE SIMCOE
Owen Sound Sub
Elora Sub
MacTier Sub
Newmarket Sub
Uxbridge Sub
LAKE SCUGOG
Guelph Sub
Owen Sound Sub
Halton Sub
Bala Sub
Galt Sub
Weston Sub
York Sub
Havelock Sub
Halton Sub
North Toronto Sub
Oakville Sub
Belleville Sub

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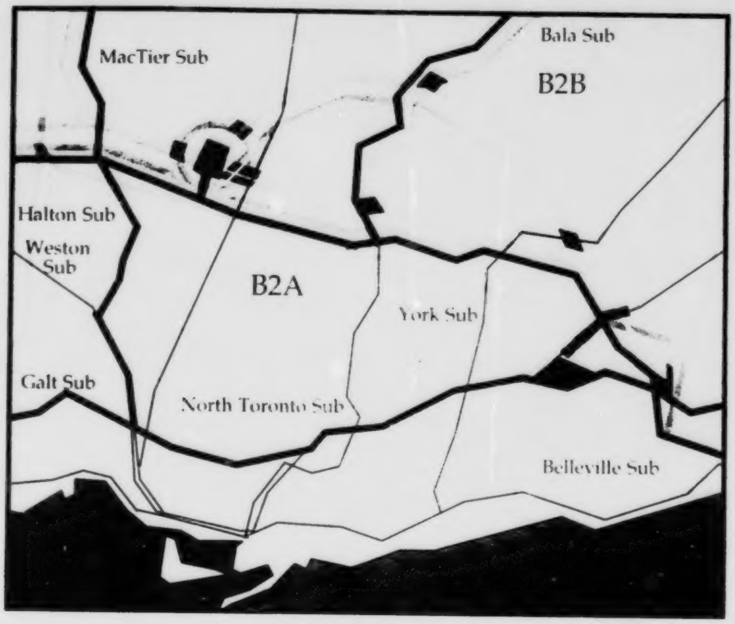
CN DG Route and Yards

CN Non DG Route and Yards

CP DG Route and Yards

CP Non DG Route and Yards

Detail showing the differences in the corridor options B2A and B2B



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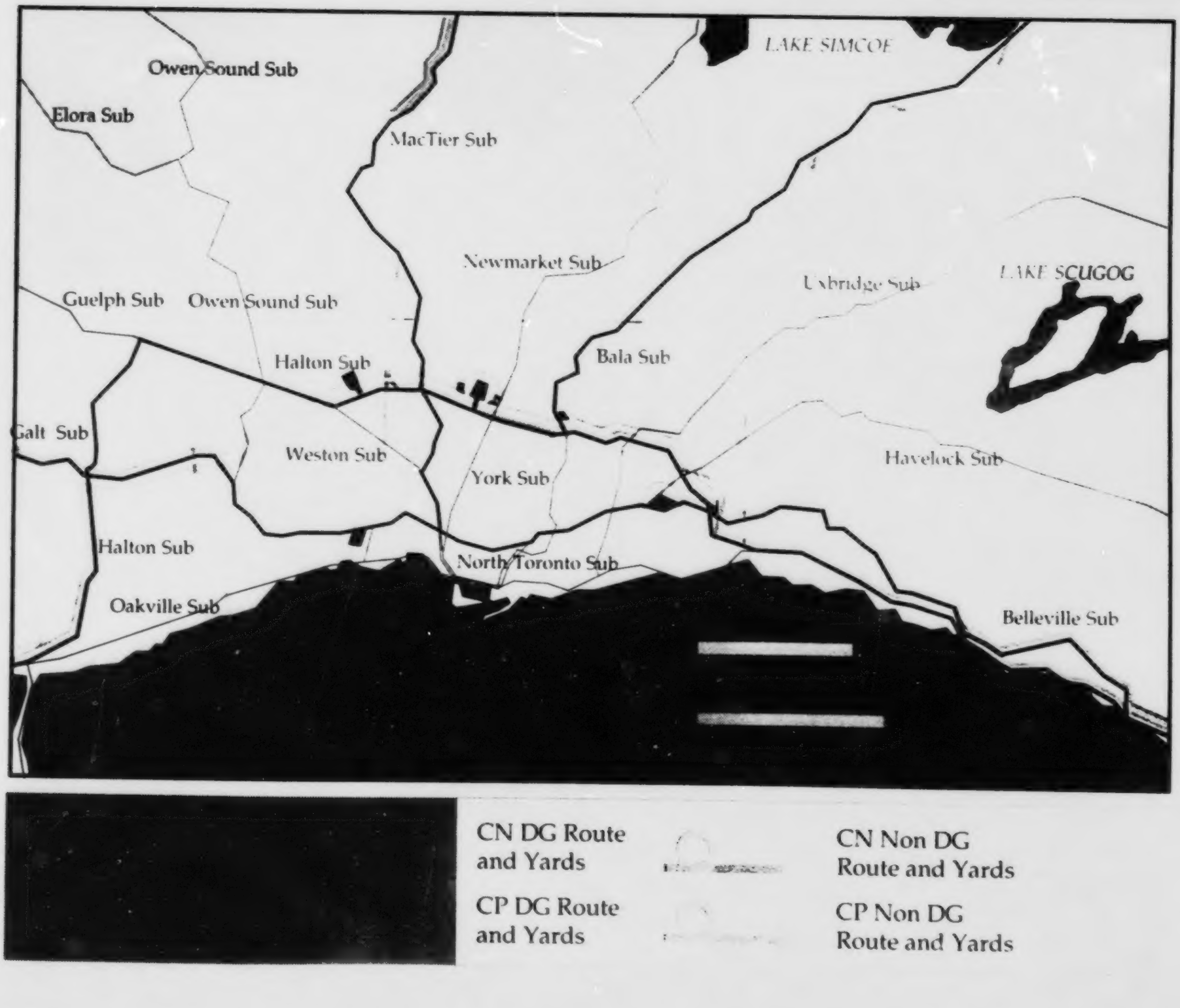

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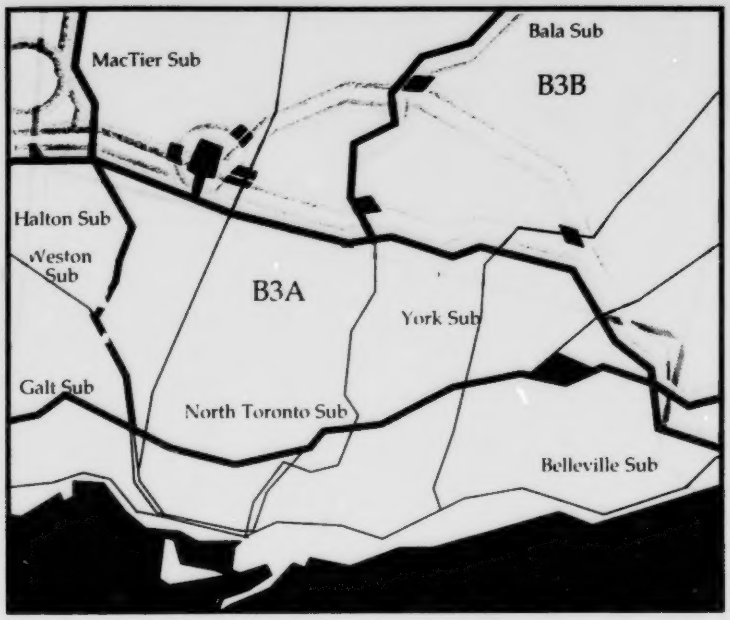
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Galt Sub
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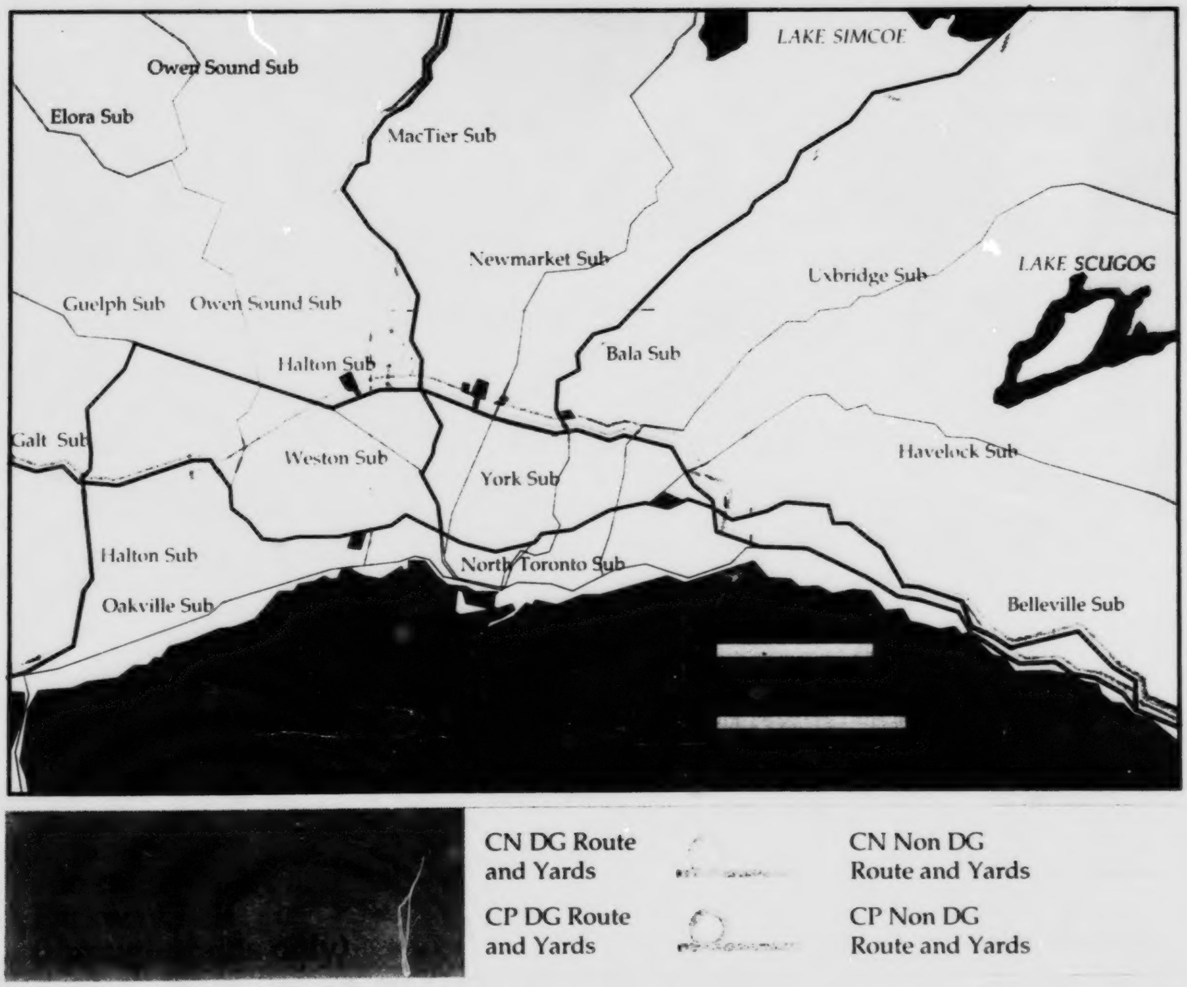
Belleville Sub

Detail showing the differences in the corridor options B1A and B1B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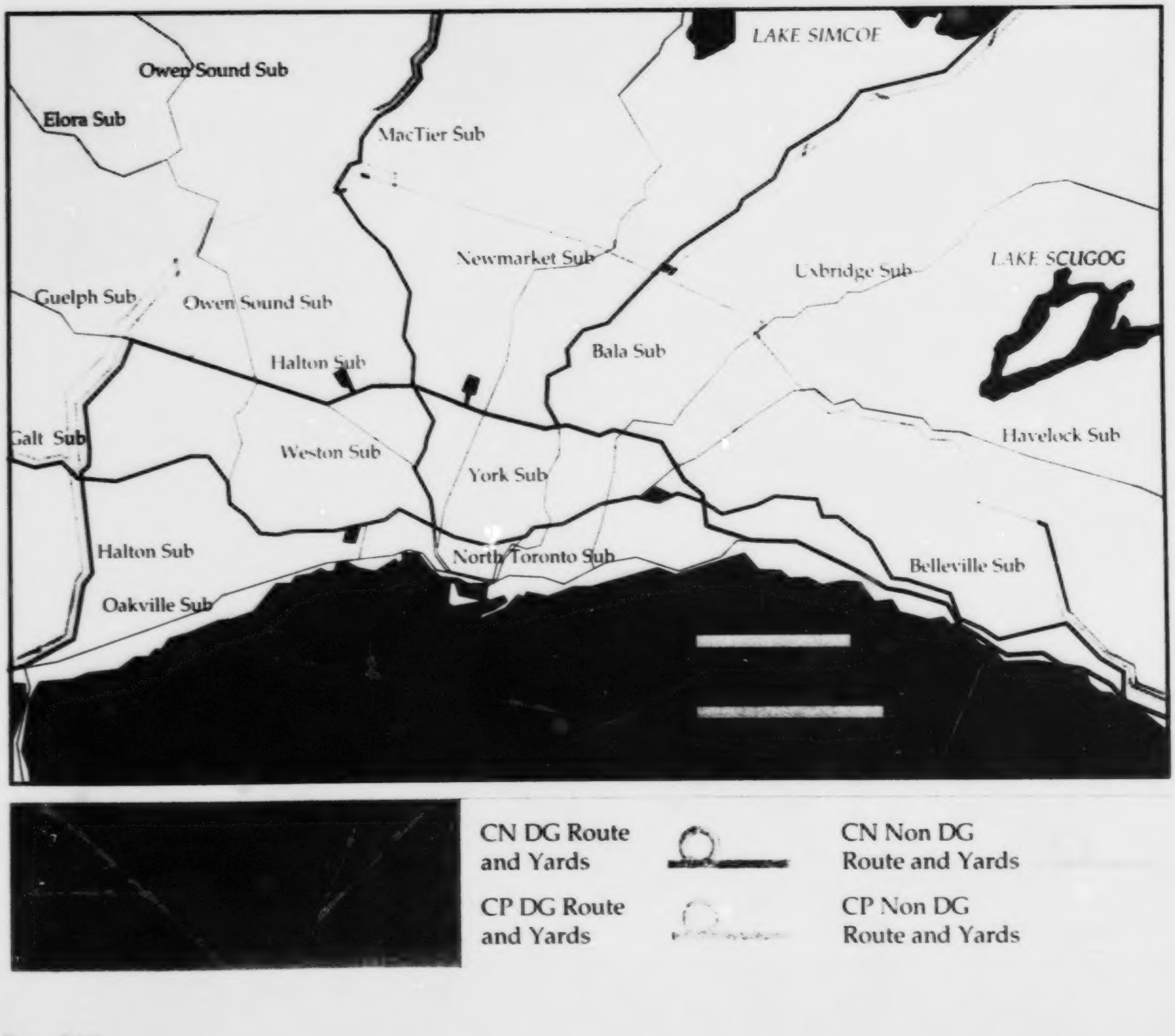
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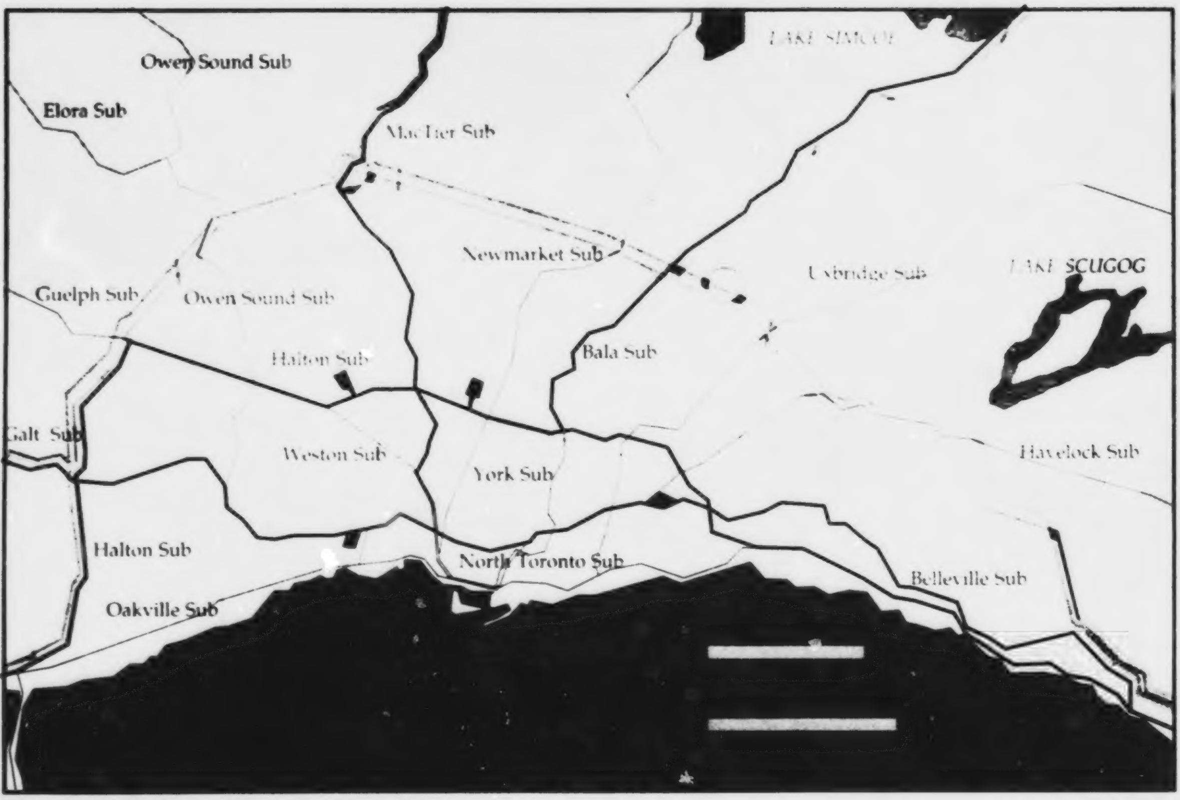
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Halton Sub
North Toronto Sub
Belleville Sub
Oakville Sub
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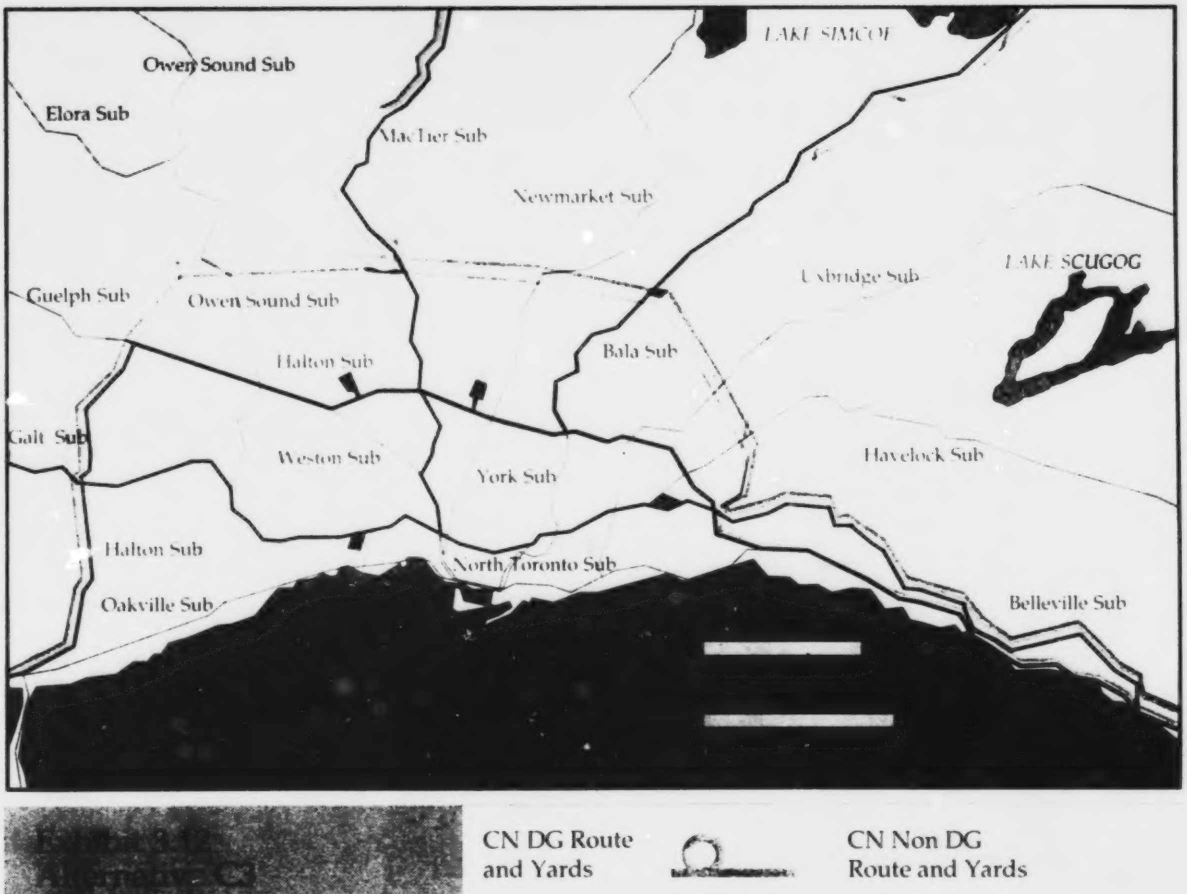
CP DG Route and Yards
CP Non DG Route and Yards

3.5 Evaluation Criteria

We used both quantitative and qualitative criteria to evaluate the routing alternatives.

The latter criteria involve such aspects as the volume of traffic that may shift to trucks under each alternative, and the effects this would have on safety and on railway competition. Other qualitative criteria involved determining whether the present system was safe, unsafe, or safe enough, and the degree of acceptance or opposition to each alternative.

Our quantitative criteria were Risk to Public Safety, Economics, Community Impacts, and Natural Environment Impacts. Recognizing that we were undertaking a feasibility study and not a precise, engineering exercise, we developed cost parameters and proxies for the quantitative criteria we wanted to measure. These are outlined as follows: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Havelock Sub
Halton Sub
North Toronto Sub
Oakville Sub
Belleville Sub
CN DG Route and Yards
CN Non DG Route and Yards
CP DG Route and Yards
CP Non DG Route and Yards

Exhibit 3.12
Alternative C3
North Corridor
(through trains only)

3.5.A Safety Impacts

We used statistical fatalities per year, arising from the effects of the release of dangerous goods from rail accidents, to help us measure risk and to help us make comparisons between different route options and segments.

It should be said that elected officials, ratepayer groups and even some members of the Task Force expressed considerable concern over the use of this criterion for public safety. Many felt it was too narrow, and that long and short term injuries and illnesses, coupled with property damage, would more appropriately reflect the true cost of the effects on public safety. However, our consultants advise us that these sub-lethal effects would be proportionate to fatalities and that, in the case of a serious dangerous goods spill, to quantify these sub-lethal effects would be a major and costly exercise which would not significantly alter the relative nature of the various alternatives we were studying. As to property damage, we took the position that while this was undoubtedly important, our major focus should be on public health and security. We are confident that the fatalities criterion does allow us to evaluate and compare the different alternatives and route segments effectively.

We note that the science of risk assessment and management is relatively new, and methodologies had never been applied in a situation as complex as this. We are confident in the conclusions drawn about the relative risk of various corridors but note that a wide range of values is possible in assessing absolute risk of dangerous goods movement in any specific corridor.

A more detailed explanation of Risk and the methodology we used are outlined shortly in Section 3.8 - Risk Assessment.

3.5.B Economic Impacts

These include estimates of costs to construct the required railway infrastructure, offset by savings (if any) realized from various relocation strategies (i.e. value of land from any rail yard relocation, or lower expansion costs for commuter rail if freight traffic volumes are reduced). The incremental operating cost for each alternative was also determined. These operating costs however did not include possible additional costs which would have to be borne by the commuter service in those cases where that service became the major user of a rail line.

Capital costs for new railway infrastructure included the cost of land, tracks and new yards, with an allowance for facilities abandoned as a result of a particular alternative. Also costed were various trackage options developed with the railways to ensure sufficient capacity to accommodate the rerouted traffic. We would stress that our estimates were for a feasibility study and are quoted in 1987 dollars.

Operating strategies and costs for each of the alternatives were developed, in close cooperation with the railways, to ensure that operating plans were practical and that the costing of these alternatives was in keeping with the recognized costing methodology and requirements of each Railway. These operating cost estimates only reflect the increased, or decreased cost, over the existing operation and as such do not reflect the total operating costs of the railways in the Greater Toronto Area. Our interest is in the relative impacts one alternative would have over another, and how these impacts would affect our final decision.

3.5.C Community Impacts

These took the form of the loss of developed, and developable land and the creation of barrier effects between communities. These criteria were measured as kilometres of rail line creating such impacts.

3.5.D Natural Environmental Impact

To give us a measurement for noise and vibration impact, we determined the number of people living within 1 kilometre of a rail line. For impacts on aquatic life and water quality, the measure we used was the number of streams that would be crossed. For larger, sensitive environmental areas the measure we employed was the number of kilometres of each rail line passing through such areas. For visual impact effects, we used the number of kilometres any new trackage would be located noticeably above the surrounding terrain.

Once again, we relied on a proxy measurement to give us an understanding of the impacts of an alternative. Recognizing, of course, that 1 kilometre of track through a highly sensitive area may be worth 3 or 4 kilometres of track through an area of a less sensitive nature, we were nevertheless comfortable that, in a feasibility study of this nature, we had a proxy measurement which could help us in our deliberations.

It should be noted that all of the impacts quoted above apply to the entire system, for each option studied, and not just to a particular route within a specific option.

3.6 Evaluation of Alternatives

3.6.A Costs and Proceeds

Capital Costs

Capital costs for different alternatives ranged from zero dollars for the existing system to $1.686 billion for the most northerly corridor option (Alternative C-2). These costs include estimates for physical plant, new yards (if needed), bridges, switches, grade separations and land required for the tracks. Some allowances have been made, where appropriate, for the sale of surplus land. Credits were given when an alternative meant rehabitation or upgrading of old facilities could be avoided. As mentioned, these costs are at 'feasibility estimate' level and are quoted in 1987 dollars.

A summary of the capital costs, per alternative, is shown in Exhibit 3.13. New trackage sections required are shown in

Exhibit 3.13
Capital Cost Estimates ($millions)

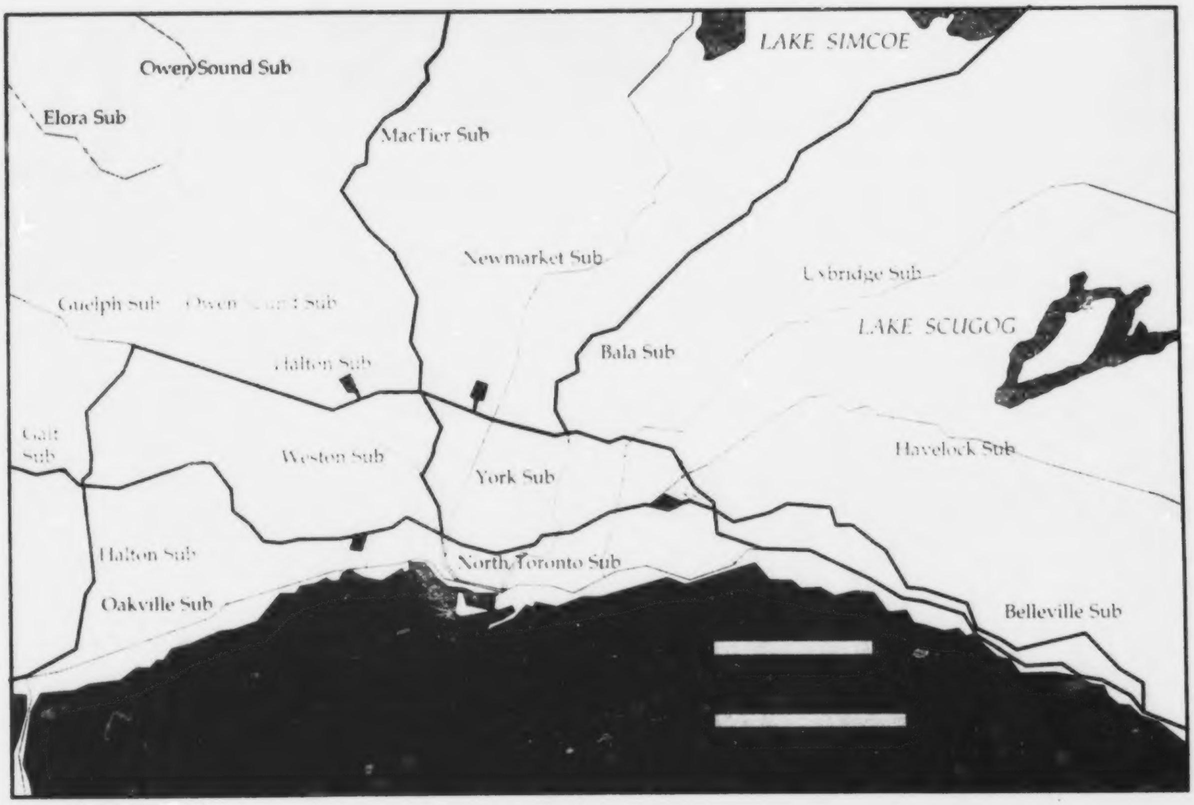
** Numbers in parentheses are estimated returns from sale of existing rail lands following provision of revised zoning. The actual amounts to be credited would depend on market factors and negotiations at the time of implementation.*
- Expressed in 1987 dollars

Alternative	Features	Infrastructure Cost	Land Cost	Total Cost
A1	NO CAPITAL COSTS	——	——	——
A2		$45	$9	$54
B1A		$365	$7	$372
B1B	Cost as B1A plus the 2 track York Sub relocation	$590	$22	$612
B2A	3 track line	$565	——	$565
	4 track line	$665	——	$665
B2B	Costs as B1A plus relocation of York Subdivision in Thornhill area			
	3 track line	$755	$15	$770
	4 track line	$860	$15	$875
B3A	3 track line	$750	$11 ($53)	$708
	4 track line	$850	$11 ($53)	$808
B3B	Cost as B3A plus relocation of York Subdivision in Thornhill area plus yard			
	3 track line	$940	$26 ($53)	$913
	4 track line	$1,045	$26 ($53)	$1,018
C1	Includes yards	$900	$153 ($53)	$1,000
C2	3 track option	$1,460	$169 ($153)	$1,476
	4 track option	$1,670	$169 ($153)	$1,686
	Includes yards			
C3	Includes yards	$665	$113 ($53)	$725

Exhibits 3.14 to 3.16 for alternatives involving the rerouting of Canadian Pacific's 'through' dangerous goods traffic only (option A-2); the Parkway Belt Corridor (the 'B' options); and the North Corridor (the 'C' options). Railway yard locations shown, should be considered as approximations since several locations were possible.

Operating Costs

Operating cost impacts ranged from an overall annual incremental saving of $1.6 million to an overall annual increase of $36.0 million, depending on the alternative studied. Exhibit 3.17 summarizes these estimated cost impacts, by railway, for each alternative studied. These are operational savings and costs over and above costs presently incurred in the existing system. We were interested not in the railways' overall costs, but only in the effects that our alternatives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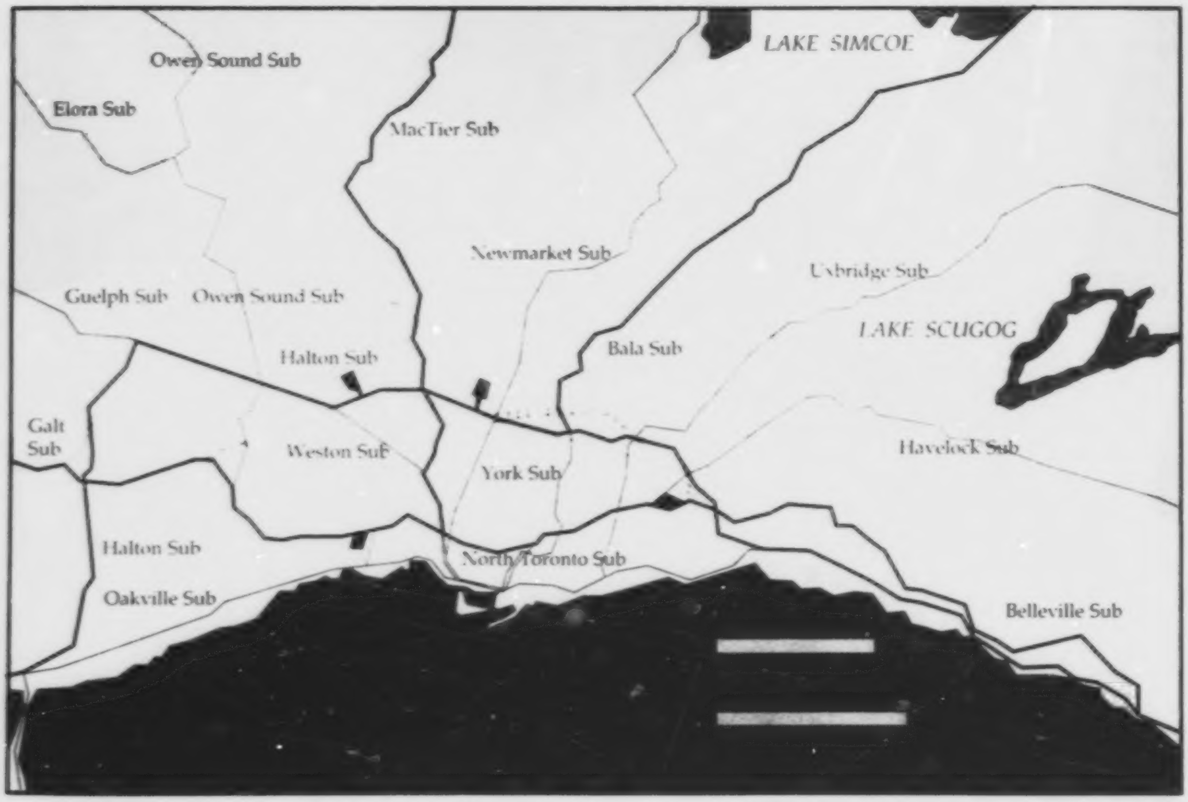
Havelock Sub
Halton Sub
North Toronto Sub
Oakville Sub
Belleville Sub
Existing rail system
Possible new rail segments

Exihibit 3.14
New Rail Segments
Existing System
Alternative A2

would have on their operations.
We would like to acknowledge the extensive and willing cooperation of both railways. They devoted enormous efforts (at no cost to the Task Force) to produce various operational scenarios in which they balanced their need to service their customers, remain competitive, and yet reduce the risk to the general public.

Traffic origin and destination flows played a large part in these operational scenarios. Since the Canadian National's main line (the Halton and York Subdivisions) is already located north of Metropolitan Toronto, most of the Parkway Belt Corridor options (the B Alternatives) yield an operational saving. Savings to Canadian National result in some cases, from shared use of their rail right-of-way, or from shorter trackage needed along some routings. But costs increased as the relocation options move further to the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Exihibit 3.15
New Rail Segments
Parkway Belt Corridor
Alternatives

Existing rail system ═

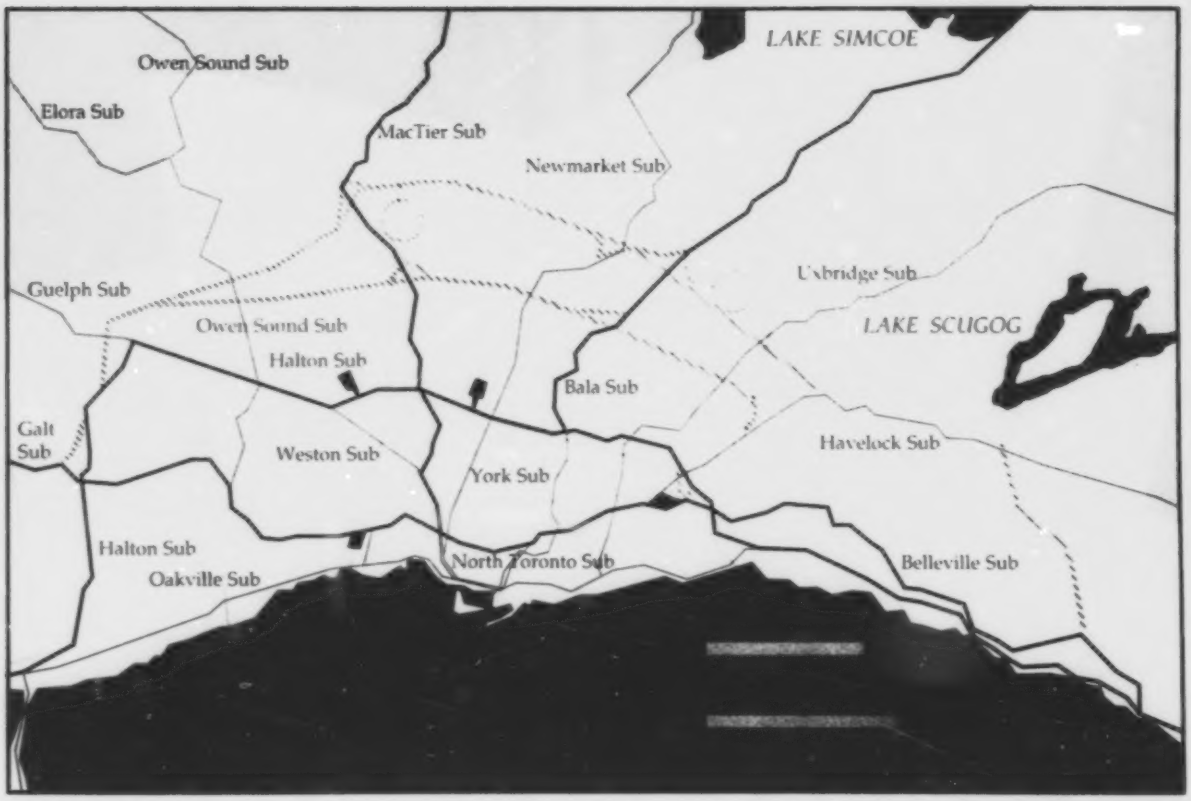
Possible new rail segments and yards ▨

North.
For Canadian Pacific, every option yields an increased operating cost. This is due to the greater distances it would be required to travel compared to its present downtown line, and the longer trackage it would have to maintain.

Proceeds

Abandonment and Sale of Specific Railway Infrastructure

At an early stage of our deliberations, we were told that the market value of certain railway rights-of-way may be sufficiently high to accommodate most, if not all, of the costs of rail relocation. Specific reference was made to the central portion of Canadian Pacific's North Toronto Subdivision in downtown Toronto, and the Canadian Pacific Agincourt Yard in Scarborough.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Exihibit 3.16
New Rail Segments
North Corridor
Alternatives

Existing rail system ═══

Possible new rail segments and yards ⁘⁘⁘

We do not agree with this claim. Through the services of Engineering International, working in association with Royal LePage Real Estate Services Limited, we determined that the best values of the railway lands in these areas range in value from a low of $288 million to a high of $408 million.

Exhibit 3.17
Estimated Incremental Operating Costs

Expressed in 1987 dollars

(Incremental Savings /Costs Relative to Current Costs Expressed in Millions of Dollars per Year)

Alternative	Features	CN	CP	Total
A2		0	+7.8	+7.8
B1A		-9.4	+7.8	-1.6
B1B	Costs as B1A plus the 2 track York Sub relocation	-9.4	+7.8	-1.6
B2A	3 track line	-9.4	+17.1	+7.7
	4 track line	-9.4	+14.4	+5.0
B2B	Costs as B3A plus relocation of York Subdivision in Thornhill area			
	3 track line	-9.4	+17.1	+7.7
	4 track line	-9.4	+14.4	+5.0
B3A	3 track line		+10.0	+0.6
	4 track line	-9.4	+8.0	-1.4
B3B	Costs as B3A plus relocation of York Subdivision in Thornhill area			
	3 track line	-9.4	+10.0	+0.6
	4 track line	-9.4	+8.0	-1.4
C1		+26.3	+9.7	+36.0
C2	3 track option	+16.8	+9.7	+26.5
	4 track option	+16.8	+9.7	+26.5
C3		+10.0	+7.8	+17.8

We studied two scenarios for the Agincourt Yard depending on whether the Havelock Subdivision would be retained or not. The breakdown of our analysis is as follows:

Land Use Scenario Analysis

i)	**North Toronto Subdivision** West Toronto Diamond to the Leaside Yard	$240 - $320 million
ii)	**Agincourt Yard**	
	Scenario (1) With the Havelock Subdivision (Peterborough - CPR line) being abandoned and the land becoming available for sale	$72 - $88 million
	Scenario (2) With the Havelock Subdivision being retained	$48 - $58 million

(These are 1986 values, which were later adjusted to 1987 dollar values when being incorporated into the overall capital and operating cost comparisons of alternatives.)

The values shown for the Canadian Pacific's Agincourt Yard have been accommodated, where applicable, in the capital cost estimates we reported earlier. However, since none of the alternatives studied involve the complete abandonment of Canadian Pacific's North Toronto Subdivision, the $240 - $320 million estimated for this Railway's right-of-way property is not reflected in any of our financial accounting.

At our public hearings, some questioned whether these estimates truly reflect current market value for the Agincourt rail yard lands. However, this land is unserviced, and costs to have it serviced would be substantial. After extensive discussions with Scarborough's planning personnel on this point, the majority of the Task Force are satisfied with these estimates established by our consultants. (One member of the Task Force feels that the land value shown for the Agincourt Yard is too low.)

There are several other major factors to consider in assessing the abandonment of Canadian Pacific's North Toronto Subdivision right-of-way:

■ Except in the highest cost alternatives, all freight traffic other than dangerous goods would continue to run on the present rail lines;

- Even if all 'through' freight traffic were removed, 'local' traffic, both for general freight and dangerous goods, would have to be accommodated;
- Options must remain available for both the Province of Ontario and the Municipality of Metropolitan Toronto to accommodate public transportation; and finally
- From all the experience encountered in establishing transportation corridors anywhere, the majority of the Task Force strongly agrees that it would be in the public interest to preserve the existing rail corridors in Greater Toronto even if their overall use is changed. (One member of the Task Force argues that it might be possible economically to relocate the North Toronto Subdivision, thus releasing land for other purposes and reducing the costs of relocation.)

We conclude that even though some lands may be abandoned through relocation or changes in traffic, the core of this transportation corridor should remain.

We recommend therefore that:

- **No consideration be given at this time to abandoning the present Canadian Pacific Railway's North Toronto Subdivision;**
- **Should rerouting or relocation take place, this right of way continue to be used for all 'local' traffic and for 'through' non-dangerous freight traffic; and that**
- **Should excess rail capacities become available on this or any other rail line in the Greater Toronto Area, consideration be first given to their use as possible public transportation corridors.**

Exhibit 3.18 indicates a complete summary of the land values appraised, in 1986 dollars, by the various 'nodes' studied. (A node is a particular stretch of land along the right-of-way appraised by our consultants).

Commuter Service (GO Transit)

The existing rail network in Greater Toronto is used jointly by the freight railways, the long distance passenger railway (VIA Rail), and GO Transit, the commuter rail system. Both passenger services reimburse the major railways for the use of their lines.

We held discussions with GO Transit to determine their growth needs and how they could use any excess rail line capacity. We then translated this extra capacity into dollars and determined a cost/saving potential for each option. By making use of excess capacity, GO Transit would save $55-

Exhibit 3.18
Summary of Land Value Estimates

N.Toronto S/D and Agincourt Yard
Expressed in 1986 $millions

North Toronto Subdivision Nodes	Area (sq.ft.)	Value Ranges in $millions Assuming $20/sq.ft. of buildable coverage Low <50%	Medium 60%	High 75%
1 The Junction	**242,000**	**$1.7** $8/sq.ft.	**$2.0** $12/sq.ft.	**$2.1** $15/sq.ft.
2 Lansdowne	**101,005**	**$0.8** $8/sq.ft.	**$1.2** $12/sq.ft.	**$1.5** $15/sq.ft.
3 Dufferin	**217,030**	**$1.7** $8/sq.ft.	**$2.6** $12/sq.ft.	**$3.3** $15/sq.ft.
4 Ossington	**126,295**	**$1.0** $8/sq.ft.	**$1.5** $12/sq.ft.	**$1.9** $15/sq.ft.
5 Christie	**300,550**	**$2.4** $8/sq.ft.	**$3.6** $12/sq.ft.	**$4.5** $15/sq.ft.
6 Bathurst	**213,500**	**$13.7** $80/sq.ft.	**$17.0** $80/sq.ft.	**$20.5**
7 Spadina	**253,750**	**$22.0** $100/sq.ft.	**$28.0** $125/sq.ft.	**$34.0** $150/sq.ft.
8 Avenue	**242,000**	**$20.3** $8/sq.ft.	**$25.4** $12/sq.ft.	**$30.5** $15/sq.ft.,
9 Yonge*	**794,392**	**$146.0**	**$168.0**	**$190.0**
10 Mt. Pleasant	**401,477**	**$24.0**	**$26.8**	**$30.0**
11 Bayview	**355,400**	**$2.7**	**$3.0**	**$3.3**
Totals		**$236.8**	**$279.6**	**$320.9**

Agincourt Yard (unserviced land)	**Low**	**High**
Scenario 1 - 320 acres	$72.0	$88.0
Scenario 2 - 265 acres	$48.0	$58.0

**Breakdown of Value estimates for #9 Yonge*

	98,536 (3.0 x cov.)	**$29.5** $300/sq.ft.	**$34.4** $350/sq.ft.	**$39.0** $400/sq.ft.
	217,030 (2.0 x cov.)	**$93.5** $225/sq.ft.	**$105.0** $250/sq.ft.	**$116.5** $275/sq.ft.
	217,030 (1.0 x cov.)	**$23.0** $125/sq.ft.	**$29.0** $150/sq.ft.	**$34.5** $175/sq.ft.
Total	**794,392**	**$146.0**	**$168.0**	**$190.0**

160 million in expansion costs, depending on the option chosen.

These figures are strictly estimates, since any actual cost avoidance would depend on negotiations between the railways and GO Transit at the time of service expansion. In addition, these figures do not reflect additional operating costs which may have to be borne by GO Transit in cases where it constitutes a greater proportion of traffic on a line after a freight railway service relocation.

Costs and Proceeds Summarized

The Economic Impacts of the alternatives are shown in Exhibit 3.19.

3.6.B Community Impacts

Two proxies were used to measure community impacts: the loss of developed or developable farm land, and the barrier or division created by rail lines within a community. Both are expressed as kilometres of rail line impacting the community.

The transfer of land use ranges from zero km for the existing system, to a high of 131.0 km for the most northerly relocation option. The existing system and one of the Parkway Belt options exhibited the highest barrier effects (219.3 km and 219.4 km respectively). This was due to the high density of population in the southern portion of the Greater Toronto Area. The further north our relocation options moved, the less this community barrier effect became.

Exhibit 3.20 summarizes the community impacts for the various alternatives.

3.6.C Natural Environmental Impacts

Natural environment impact proxies were selected to help us understand the effects, in terms of noise, vibration and visual impacts, that each option would have on the general public. We also assessed the potential adverse effect our options would have on the environment as a whole.

With respect to noise and vibration, the larger the population, the greater the impact. Naturally, the existing system had the highest impact. The further north our options moved , the less impact there was to measure. It should be pointed out, however, that because of the diverse and extensive development mushrooming all over the Greater Toronto Area, the impact in these areas was of growing concern to the Regions.

Visual impacts, reflecting the creation of new sights not previously in evidence (i.e. new rail lines), showed that the further north our options went, the higher the impact. However, when visual effects are considered in combination with the population affected by noise and vibration, concern would be more strongly expressed by those living in the Parkway Belt Corridor options (the 'B' Alternatives).

Our consultants counted the number of streams crossed by rail lines and, working from environmental maps, we calculated the number of kilometres that these lines would cross in environmentally sensitive areas such as the Humber Val-

Exhibit 3.19
Economic Impacts

Capital Cost ($ million)
Operating Costs (capitalized) ($ million)
Impact on Planned Commuter Service ($ million)
Buffers ($million) *Refer to section 3.12*

**Capital costs shown are net of estimated return from sale of existing rail yards. Operating cost / savings have been capitalized over fifty years. Numbers in brackets denote potential cost reductions rather than costs. Actual cost reductions from impacts on rail commuter service would depend on negotiations between the railways and Go Transit if improved commuter services were to be implemented.*

Exhibit 3.20
Community Impacts

Loss of Developed Land (km)
Loss Developable Land (km)
Loss of Farm Land (km)
Community Barrier Effects (km)

Exhibit 3.21
Natural Environmental Impacts

Noise and Vibration Exposure (people)
Visual Impact Effects (km)
Water Quality/Aquatic Life Effects (crossings)
Spec. Vegetation/Wildlife Area Effects (km)

ley. The existing system crosses the most streams and the most northerly option the least. When counting the number of sensitive areas crossed, the reverse was true.

We would like to emphasize that our environmental criteria are not a replacement for a legally-required Environmental Assessment Study. A full Environmental Assessment may have to be carried out on any alternative line actually selected. Our criteria are intended solely to give a rough approximation of the environment implications for each alternative.

Exhibit 3.21 summarizes the natural environmental impacts.

Existing System		Parkway Belt Corridor						North Corridor		
A1	**A2**	**B1A**	**B2A**	**B3A**	**B1B**	**B2B**	**B3B**	**C1**	**C2**	**C3**
0	54	372	615	758*	612	823	966*	1,000*	1,581*	725*
0	142	(29)	115	(7)	(29)	115	(7)	657	484	325
0	0	(55)	(130)	(130)	(72)	(147)	(147)	(108)	(162)	(107)
								300	to	500

Existing System		Parkway Belt Corridor						North Corridor		
A1	**A2**	**B1A**	**B2A**	**B3A**	**B1B**	**B2B**	**B3B**	**C1**	**C2**	**C3**
0.0	0.0	12.5	12.5	12.5	16.0	16.0	16.0	6.5	6.5	1.5
0.0	0.0	1.5	1.5	1.5	6.5	6.5	6.5	3.0	3.0	5.5
0.0	0.0	14.0	14.0	14.0	24.0	24.0	24.0	121.5	121.5	89.0
219.3	219.3	219.4	146.5	146.5	194.7	122.3	122.3	119.8	41.3	92.5

Existing System		Parkway Belt Corridor						North Corridor		
A1	**A2**	**B1A**	**B2A**	**B3A**	**B1B**	**B2B**	**B3B**	**C1**	**C2**	**C3**
1,199	1,999	1,112	530	530	1,067	484	484	499	79	584
0.0	0.0	4.0	4.0	4.0	7.0	7.0	7.0	52.0	52.0	24.0
369	320	331	331	331	344	344	344	285	285	299
19.5	19.5	16.5	12.0	12.0	16.5	12.0	12.0	89.0	57.0	14.0

3.7 Interim Conclusions

With respect to engineering, railway operations and land availability, rerouting and relocationg the rail flow of dangerous goods in the Greater Toronto Area is indeed feasible. There would however be some adverse environmental and social/community effects, as documented above.

But there is another critical perspective to consider: the reduction of risk achieved by each alternative. This is discussed in the next section.

3.8 Risk Assessment

3.8.A General

We have determined that rerouting and relocating the rail flow of dangerous goods in the Greater Toronto Area can be achieved from an engineering and operational point of view but at a cost. Our mandate, however, was one of public safety. We therefore had to determine if, and how, our options impacted public safety, and whether they could significantly reduce risk to the public.

Risk Assessment is a relatively new field. We would like to acknowledge and thank Dr. D.H. Napier, of the University of Toronto, for introducing us to this entire question of the measurement of risk and its complications. His urging, at the beginning of our deliberations, helped convince us that such an examination was necessary.

Our Chairman's trip to Great Britain confirmed this conclusion. There, they have recognized the value of undertaking extensive quantitative risk assessments when major projects are contemplated. We are grateful also to the British Health and Safety Executive for their comments on the approach we were taking and for their support in this regard.

The Health and Safety Executive started doing risk assessments first on factories and plants, and are only now working on the railway transportation system. The rail system was given a lower priority because British Rail had an excellent safety record, and already comes under comprehensive regulations. It appears that at a governmental level, we in Canada have started at the other end of the spectrum (i.e. the railway transportation system) first, even though our rail regulations are more stringent and our rail safety record just as good.

Officials in the Railway Transport Committee advised us that quantitative risk assessment is a new and untried field for Canada. They urged that we proceed with caution, defining in clear and unequivocal terms what we wanted to analyze in this exercise and what we wanted to achieve. We are grateful for their advice and words of caution.

3.8.B Methodology

Our objective was to measure the degree to which various routing alternatives would reduce the risk to the public from the transportation of dangerous goods in the Greater Toronto Area. We needed to understand risk in detailed and precise terms - what it was, how it could be measured and the meaning of the results.

In simplified terms, risk is the probability of some event happening, multiplied by the effects caused by that event. In this case, we were concerned with the probability and effects of a rail accident involving dangerous goods.

But we were dealing with a number of different types of potential hazards (i.e. toxic gas clouds, thermal radiation from fires, detonations and blast waves from expanding vapour) and over 3000 dangerous goods products. We chose to study blastwaves, fires (encompassing pool and jet fires, fireballs and flammable clouds) and toxic gas clouds, the more hazardous of the many events that could occur. We further selected seven dangerous goods products on which we would undertake our detailed examination. These products were carefully selected to be truly representative of the volumes of dangerous goods likely to travel through the Greater Toronto Area by rail, from now to the year 2011. These products were also the most hazardous in their class, because we wanted to err on the side of public safety. Throughout the analysis, conservative factors and estimates were used.

We decided that we needed to quantify the relative risk of the existing system in precise terms, not only as a total over the entire system but for each segment within the system as well. We wanted to pay particular attention to areas identified by the public as being of extremely high risk. We also wanted to compare this system risk with other risks in society. Finally, we would then quantify the risks on the alternative options and compare these with the existing system.

But there is a difference between absolute risk and relative risk. Absolute risk is the precise calculation of the frequency and magnitude of specified consequences of all possible events dealing with a particular hazard, while relative risk is the comparative frequencies and magnitudes, under alternative situations, such as we were undertaking. We chose the relative risk approach. This is less precise than absolute risk calculations, and as such does not calculate specific hazardous installations near rail lines or the additional risk effects caused by low mobility of some segments of the population. We nevertheless believe this relative risk is more than adequate for comparing the alternatives under study.

Our consultants advised us that the absolute risk could either be two times higher or ten times smaller than the relative risk values we used. They felt conservatively that the real or absolute risk was probably a third of the figures we used.

In our product selection, we included five of the nine classes of dangerous goods classified in the Transportation of Dangerous Goods Act. For those classes, in which no product was selected, we deemed that the volumes of product moved by rail was, or would be, either non-existant in the Greater Toronto Area or the volumes were so minimal that the potential risk could not be measured.

All products chosen were of the special dangerous goods category (tending again to the pessimistic scenario) with the exception of gasoline. This product was chosen because of its flammability hazard and the significant volumes transported through the Greater Toronto Area by rail.

Exhibits 3.22 and 3.23 describe, in more detail, the hazardous release events and products we selected to be our representative sample. Exhibit 3.24 shows the quantities of the various chemical classes transported in the Greater Toronto Area in 1985.

Societal Versus Individual Risk

To determine societal risk, one would calculate, for example, how many persons would be at risk in the event of an accident or accidents. For individual risk, the task is to calculate the chance and amount of harm that would occur to a single person exposed to a hazardous event. Both calculations, we felt, were useful. In the case of societal risk, we could get an appreciation for the total risk involved; in the case of individ-

Exhibit 3.22
Hazardous Release Events

Blastwaves	■ due to detonation of explosives, such as black powder, or unconfined (flammable) vapour cloud explosions (UVCEs)
Fires	■ pool fires from pools of flammable materials such as gasoline ■ jet fires from release of flammable materials, such as propane, from pressurized vessels ■ fireballs from boiling liquid expanding vapour explosions (BLEVEs) of pressure liquefied flammable gases such as propane ■ flammable clouds from release of flammable substances such as propane.
Toxic Gas Clouds	■ from release of toxic substances such as chlorine, ammonia or oleum or from the combustion products from burning of substances such as phosphorus.

ual risk, this would be useful to us in our examination of buffer widths as they impacted the individual. (These are discussed later in the section entitled 'Buffers'.)

System Versus Segmental Risk

System risk is defined as that figure which represents the risk for the total system, or for a total alternative/option under study, and is an aggregation of many societal, segmental risk calculations. Segmental risk is a relatively complex calculation involving the types and volumes of dangerous goods traversing a certain area by rail, and the potential for different types of accident(s) that could occur in that area. Segmental risk also involves the meteorological, topographical and population density characteristics (daytime and night-time) of that location, and combines all these with previously determined human vunerability and release data. Population proximity, as opposed to density, to the line was also an important factor.

We used sophisticated computer models which took into account the time-varying nature of accidental releases; exposure time and human dose/response relationships; and the differences in human vulnerability. We examined Canadian

Exhibit 3.23
Transport Canada Dangerous Goods Classification

**Special Dangerous Commodities (S.D.C.)*

Representative chemicals used for risk assessment are underlined

Classes	Examples (Chemicals of Materials)
Class 1: Explosives	
1.1 Mass explosion hazard	Nitrocellulose (dry)*, black powder*
1.2 Projection hazard	Fireworks (Type B)*
1.3 Violet fire hazard	Signal cartridges
1.4 Localized explosion effects	Explosive rivets
1.5 Insensitive with a mass explosion hazard	Blasting explosives (Type E)
Class 2: Gases	
2.1 Flammable liquid	Propane*, LPG*, ethylene*
2.2 Non-flammable gas	Carbon dioxide, nitrogen, nitrous oxide*
2.3 Poisonous gas	Sulpher dioxide*, hydrogen fluoride*, fluorine*
2.4 Corrosive gas	Chlorine*, ammonia*
Class 3: Flammable Liquids	
3.1 Flammable liquid	Gasoline, naphtha
3.2 Flashpoint between - 18C & 23C	Benzene
3.3 Flashpoint between - 23C & 37.8	Styrene (inhibited)
Class 4: Flammable Solids	
4.1 Flammable solid	Naphthalene
4.2 Spontaneously combustible	Phosphorus*, nickel catalyst
4.3 Dangerous when wet	Calcium carbide
Class 5: Oxidizing substances & Organic Peroxides	
5.1 Oxidizing substance	Hydrogen peroxide, ammonium nitrate fertilizer
5.2 Organic Peroxide	Benzoyl peroxide
Class 6: Poisonous & Infectious Substances	
6.1 Poisonous substance	Oleum/SO_3*, phenol*
6.2 Infectious substance	(Various)
Class 7: Radioactive Materials	Yellow cake (uranium)
Class 8: Corrosive substances	Acetic acid, nitric acid (fuming)*
Class 9: Miscellaneous Products	
9.1 Miscellaneous dangerous goods	Formaldehyde, white asbestos
9.2 Environmentally hazardous substance	(Various)
9.3 Hazardous waste	(Various)

Exhibit 3.24

1985 Dangerous Goods Rail Traffic By Commodity Classification

Through traffic neither originates nor terminates in the Toronto C.M.A.
D.C. = Dangerous Commodity
S.D.C. = Special Dangerous Commodity
Classification is that of United Nations. The addition of Class 9 is used inNorth America only.

Commodity Classification		Total Car Loads			Percentage Through Traffic		
		CN	CP	Total	CN	CP	Total
Class 1 Explosives	D.C.	89	32	121	98.88	78.12	93.39
Class 2.1 Gases	D.C.	1	11	12	0.00	0.00	0.00
Class 2.2 Gases	D.C.	61	18	79	100.00	72.22	93.67
Class 2.3 Gases	D.C.	0	0	0	0.00	0.00	0.00
Class 2.4 Gases	D.C.	0	0	0	0.00	0.00	0.00
Class 3.1 Liquids	D.C.	3065	771	3836	52.37	37.48	49.37
Class 3.2 Liquids	D.C.	1081	2359	3440	40.98	47.99	45.78
Class 3.3 Liquids	D.C.	736	1078	1814	94.02	94.34	84.21
Class 4.1 Solids	D.C.	16	88	102	100.00	63.95	69.61
Class 4.1 Solids	D.C.	87	87	174	100.00	89.66	94.83
Class 4.1 Solids	D.C.	178	226	404	100.00	93.36	98.29
Class 6.1 Poisonous	D.C.	87	48	136	60.92	95.92	73.53
Class 5,8.2,7,8,9	D.C.	4229	7490	11719	75.80	90.75	85.28
Class 1 Explosives	S.D.C.	52	0	52	100.00	0.00	100.00
Class 2.1 Gases	S.D.C.	8661	4011	12672	86.64	83.45	85.83
Class 2.2 Gases	S.D.C.	1	0	1	100.00	0.00	100.00
Class 2.3 Gases	S.D.C.	110	320	430	96.36	100.00	99.07
Class 2.4 Gases	S.D.C.	2938	654	3592	94.62	93.43	94.40
Class 3.1 Liquids	S.D.C.	0	8	8	0.00	100.00	100.00
Class 3.2 Liquids	S.D.C.	0	180	180	0.00	100.00	100.00
Class 3.3 Liquids	S.D.C.	0	0	0	0.00	0.00	0.00
Class 4.1 Solids	S.D.C.	0	0	0	0.00	0.00	0.00
Class 4.1 Solids	S.D.C.	5	2	7	100.00	100.00	100.00
Class 4.1 Solids	S.D.C.	26	0	26	100.00	0.00	100.00
Class 6.1 Poisonous	S.D.C.	278	854	1132	98.20	50.12	61.93
Class 5,8.2,7,8,9	S.D.C.	68	419	487	33.82	92.36	84.19
Mixed Loads	D.C.	16052	10292	25794	10.91	9.52	10.36
Combustibles	D.C.	83	339	422	6.02	84.96	69.43

Transport Commission Accident Records for the six year period 1980 - 1985 for both Canadian National Railways and Canadian Pacific Railway. Each accident was classified by its reported, base-accident cause. We then adjusted this Canada-wide data, using appropriate modifiers, to reflect the local traffic and track characteristics of a given segment in the Greater Toronto Area rail system. In each segment, the physical track characteristics were defined in terms of location and quality and were further categorized as main-line track segments, switching segments, or marshalling yards.

We studied 45 different linear rail segments, each having varying lengths depending on their main line or switching characteristics; six rail yards; and the population at risk within four band widths of 250/500/1000/1000+ metres on all sides of the rail lines and yards mentioned above.

We are convinced that the work undertaken in this area has been of a most comprehensive nature, breaking new ground not only in Canada, but internationally. We know of no similar work, in any country, involving a rail transportation system in a densely populated urban area.

3.8.C Risk Findings

We determined that the societal risk for the existing system in 1991 in the Greater Toronto Area is estimated at 4.1 statistical fatalities per year. (The reader is reminded that our consultants believe that absolute or true risk may be one third of this 4.1 figure.) We further determined that this 4.1 risk figure could indeed be reduced, through the implementation of our rerouting and relocating alternatives, to around an estimated 2.5 statistical fatalities per year (a 40% reduction) in the Parkway Belt corridor options and reduced even further to an estimated 1.0 statistical fatality per year (a 75% reduction) in the North Corridor options . The option of rerouting the dangerous goods off the existing Canadian Pacific North Toronto Subdivision onto the Canadian National York Subdivision (Alternative A-2) exhibit the same risk reduction as did the Parkway Belt Corridor options. (Due to population growth to the year 2011, the above risk reductions would be 35% and 67% respectively for the Parkway Belt and the North Corridor options.)

Exhibits 3.25 and 3.26 display, numerically and graphically the societal risk for each of the alternatives under study.

We further determined the segmental risk for the many parts of the existing system and the alternative options we studied.

Exhibit 3.27 contains the rail system of the Greater Toronto Area divided into segments. Segment Numbers shown on this Exhibit will be of assistance when referring to Exhibits 3.28 to 3.31. In other words, Segment 24 (on Exhibit 3.27) will be shown as Segment A1-24 on Exhibit 3.28 and so on.

Exhibits 3.28 to 3.32 show examples of segmental risks by alternative and Exhibits 3.33 to 3.37 show the same information graphically. This information is useful in determining how system risk can be altered through the various alternatives. For more indepth analysis, reference should be made to our consultants' report on Risk Assessment appended as a separate volume to this Report.

We identified four areas of higher risk when compared to the other segments in the entire system. These were:

High Risk Segments
(Refer to Exhibit 3.33)

Segment No.	Description	Societal Risk Rate (Fatalities/km/year)
a) A1-05	The Canadian Pacific Galt/ North Toronto Segment (3 kilometres)	.0780
b) A1-06	The Canadian Pacific North Toronto Segment (9.1 kilometres)	.0400
c) A1-20	The Canadian National York Segment (7.3 kilometres)	.0267
d) A1-27	The Canadian National MacTier/Weston Segment (7.1 kilometres)	.0204

(While Segments A1-20 and A1-27 are included in the above listing, they are considerably lower in risk than Segment A1-05. Reference should also be made to the minority position noted at the end of section 3.8.C)

Canadian National's McMillan rail yard and the Canadian Pacific's yards at Agincourt, Lambton and Ray Ave. also indicated a higher than general risk potential.

There was an uneven distribution of risk within the total rail system with the highest risk segment (.078 estimated fatalities/km/year) having 26000 times more risk than the segment with the least risk (.000003 estimated fatalities/km/year). This is due to increased population densities, land use, vehicular traffic densities, congestion, and street systems. All these are occurring in the same locations as increased rail congestion, which requires a larger number of switches and handling operations.

(At this point we wish to record the minority position of two Task Force members. They feel that the relative risk figures of 4.1, 2.5 and 1.0 statistical fatalities used for the Existing System, Parkway Belt and North Corridor alternatives may be viewed too literally. Since our consultants have indicated that the absolute risk lies somewhere between twice to one tenth of the figures we have used (but are probably about one third of our figures), and given the relative newness of this science, the minority Task Force members wish to emphasize that the risk figures should be viewed more as a range, with

Exhibit 3.25
Societal Risk for Rail System Alternatives

**Indicates the alternatives for which detailed risks were assessed.*
***Inferred through examination of results and comparison with the alternatives for which detailed risks were assessed.*

Alternative	Network	CN Traffic Routing	CP Traffic Routing	Societal Risk (fatalities/year) 1991	Societal Risk (fatalities/year) 2011
A1*	Existing	Existing	Existing	4.1	4.6
A2*	Existing with additional connections	Existing (A1)	Diversion of CP mainline DG trains to Halton/York Subs	2.4	3.3
B1A	Sub-route 'A' follows the CN York Subdivision Sub-route 'B' follows the Hwy. 407 Parkway Belt Corridor diverting (by passing) around Thornhill	Milton cut off for all through Halton Sub trains	Route B for mainline DG trains only, Agincourt Yard	2.5**	3.0**
B1B				2.3**	2.9**
B2A*		Same as B1A or B1B	Route B for mainline DG trains, Agincourt Yard	2.5	3.0
B2B*				2.3	2.9
B3A		Same as B1A or B1B	Route B for all mainline trains, new Woodbridge Yard	2.5**	3.0**
B3B				2.3**	2.9**
C1*	Most northerly alignment	Mainline trains carrying DG's; set-off through DG cars at Vandorf & Cherry to avoid bringing them into MacMillan Yard	Route C1 for all mainline trains, new yard in Bolton area	1.0	1.5
C2	Same as C1	Route for all mainline trains, new yard in Vandorf Area	Same as C1	1.0**	1.5**
C3*	Most southerly alignment	Mainline trains, carrying DG's; set-off of through DG cars at Elgin and North Maple to avoid bringing them into MacMillan Yard	Route C2 for all mainline trains, new yard in Bolton area	1.1	1.7

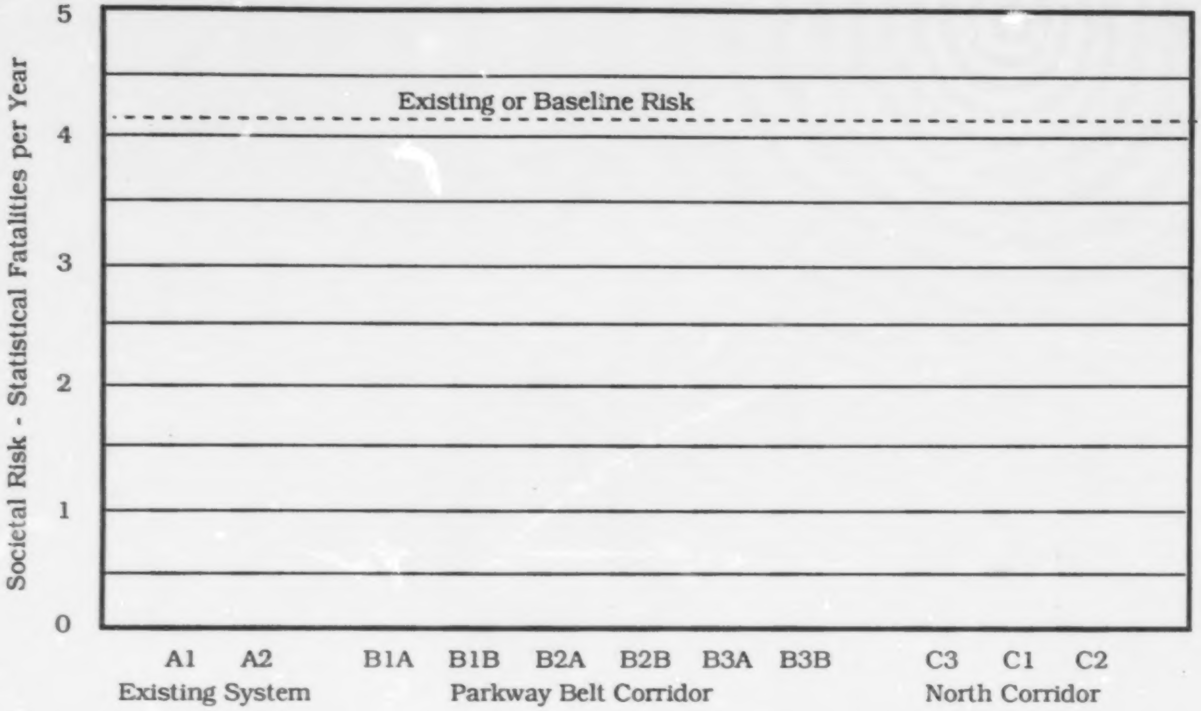
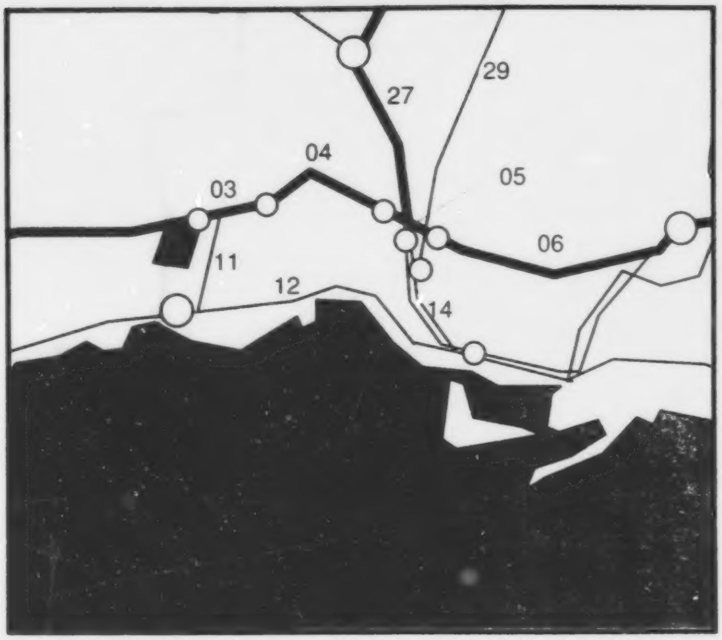


Exhibit 3.26
Comparison of Societal Risks for Rail System Alternatives

the real risk lying at about 1.4, .08 and .03 respectively for the above alternatives.

This minority position further wishes to stress that the line above which high risk is determined should also be viewed with some latitude. Our consultants have shown that risk of one statistical fatality in every 10 to 100 years equates to a societal segmental risk rate of .020 and above — thereby identifying two Canadian Pacific and two Canadian National rail segments as 'high risk'. However, if the high risk rate had been set at .040 and above, only the Canadian Pacific North Toronto Subdivision segments would have been identified as high risk. It is their opinion therefore that care should be taken in selecting this high risk identifier, since it could have applications outside the Greater Toronto Area.)

Since, however, the figures of 4.1, 2.5 and 1.0 have been substantiated and documented by our consultants; since any other figure is at best a professional judgement; and since we are, as stated on several occasions, undertaking a feasibility study of relative comparisons, we are of the opinion there-



Segment detail of downtown Toronto

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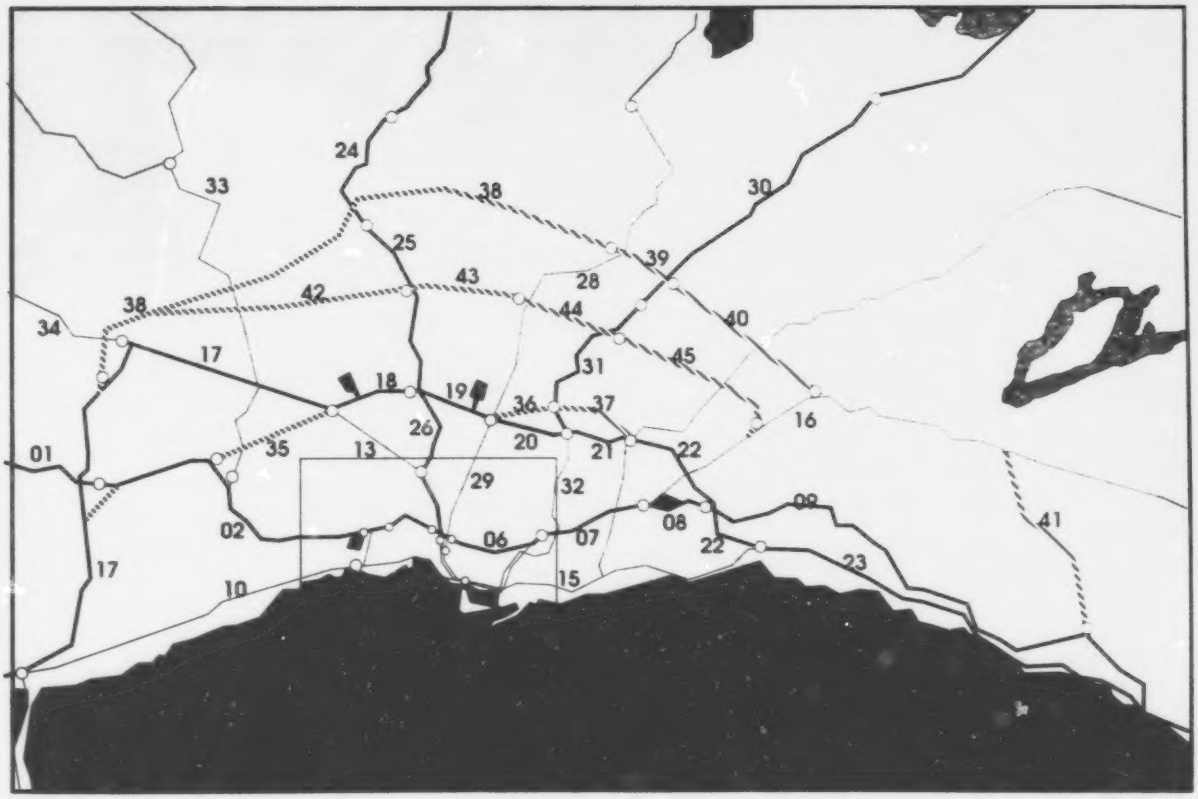

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Exhibit 3.27
Rail System Segments

Some segment lengths vary between alternatives due to operational differences.
Segments relate to system alternatives shown on Exhibits 3.28 to 3.32

Exhibit 3.28
System Risk By Segment Alternative A1 for 1991

Segment	Subdivision	Length (km)	Societal Risk For Segment (Fatalities/Per Year)	Societal Risk Rate Along Segment (Fatalities/Year-km)
A1-01	CP Galt	15.6	0.0464	0.0030
A1-02	CP Galt	34.5	0.1707	0.0049
A1-03	CP Galt	2.4	0.0300	0.0125
A1-04	CP Galt	3.9	0.0675	0.0173
A1-05	CP Galt/N.Toronto	3.0	0.2341	0.0780
A1-06	CP N.Toronto	9.1	0.3642	0.0400
A1-07	CP Belleville	12.5	0.1793	0.0143
A1-08	CP Belleville	4.6	0.0259	0.0056
A1-09	CP Belleville	64.3	0.1026	0.0016
A1-10	CN Oakville	38.0	0.1180	0.0031
A1-11	CP Canpa	4.2	0.0110	0.0026
A1-12	CN Oakville	13.4	0.0201	0.0015
A1-13	CN Weston	9.4	0.0004	0.000043
A1-14	CN Weston	5.7	0.0282	0.0049
A1-15	CN Kingston	32.6	0.0055	0.00017
A1-16	CP Havelock	42.8	0.0007	0.000017
A1-17	CN Halton	65.6	0.3848	0.0059
A1-18	CN Halton	7.6	0.0646	0.0085
A1-19	CN Halton/York	9.0	0.0208	0.0023
A1-20	CN York	7.3	0.1947	0.0267
A1-21	CN York	8.0	0.0435	0.0054
A1-22	CN York	23.4	0.0050	0.00021
A1-23	CN Kingston	52.5	0.1061	0.0020
A1-24	CP MacTier	16.4	0.0060	0.00036
A1-25	CP MacTier	17.8	0.0095	0.00053
A1-26	CP MacTier	9.2	0.0179	0.0020
A1-27	CP MacTier/CN Weston	7.1	0.1448	0.0204
A1-28	CN Newmarket	44.6	0.0131	0.00029
A1-29	CN Newmarket	14.2	0.0589	0.0041
A1-30	CN Bala	21.3	0.0141	0.00066
A1-31	CN Bala	62.0	0.0462	0.00075
A1-32	CN Bala	22.9	0.0589	0.0026
A1-33	CP Owen Sound	57.9	0.0001	0.000003
A1-34	CN Guelph	13.5	0.0005	0.000037
	Yards			
A1-Y1	CN MacMillan		0.6776	
A1-Y2	CN Mimico		0.0015	
A1-Y3	CN Don		0.0059	
A1-Y4	CP Agincourt		0.0931	
A1-Y5	CP Lambton		0.6068	
A1-Y6	CP Obico		0.0045	
A1-Y7	CP Ray Ave		0.0917	

Total Societal Risk for Toronto Area Rail System
= Sum of Societal Risks for all Segments = 4.1 Fatalities/Year

Exhibit 3.29
System Risk By Segment Alternative A2 for 1991

Segment	Subdivision	Length (km)	Societal Risk For Segment (Fatalities/Years)	Societal Risk Rate Along Segment (Fatalities/Year-km)
A2-01	CP Galt	15.6	0.0476	0.0031
A2-02a	CP Galt	10.1	0.0105	0.0010
A2-02b	CP Galt	24.2	0.0209	0.00086
A2-03	CP Galt	2.4	0.0031	0.0013
A2-04	CP Galt	3.9	0.0073	0.0019
A2-05	CP Galt/N.Toronto	3.0	0.0236	0.0088
A2-06	CP N.Toronto	9.1	0.0151	0.0017
A2-07	CP Belleville	12.5	0.0076	0.00061
A2-08	CP Belleville	19.4	0.0508	0.0026
A2-09	CP Belleville	49.5	0.0682	0.0014
A2-10	CN Oakville	38.0	0.0994	0.0026
A2-11	CP Canpa	4.2	0.0002	0.000052
A2-12	CN Oakville	13.4	0.0201	0.0015
A2-13	CN Weston	9.4	0.0004	0.000043
A2-14	CN Weston	5.7	0.0282	0.0049
A2-15	CN Kingston	32.6	0.0055	0.00017
A2-16	CP Havelock	42.8	0.0007	0.000017
A2-17	CN Halton	65.6	0.4756	0.0073
A2-18a	CN Halton	7.3	0.0530	0.0073
A2-18b	CN Halton	0.8	0.0063	0.0078
A2-19	CN Halton/York	9.0	0.0269	0.0030
A2-20	CN York	7.3	0.2588	0.0355
A2-21	CN York	8.0	0.0670	0.0084
A2-22a	CN York	12.0	0.0034	0.00029
A2-22b	CN York	11.4	0.0026	0.00023
A2-23	CN Kingston	52.5	0.1061	0.0020
A2-24	CP MacTier	16.4	0.0060	0.00036
A2-25	CP MacTier	17.8	0.0093	0.00052
A2-26	CP MacTier	9.2	0.0024	0.00026
A2-27	CP MacTier/CN Weston	7.1	0.0274	0.0039
A2-28	CN Newmarket	44.6	0.0131	0.00029
A2-29	CN Newmarket	14.2	0.0589	0.0041
A2-30	CN Bala	21.3	0.0141	0.00066
A2-31	CN Bala	62.0	0.0467	0.00075
A2-32	CN Bala	22.9	0.0589	0.0026
A2-33	CP Owen Sound	57.9	0.0001	0.000003
A2-34	CN Guelph	13.5	0.0005	0.000037
	Yards			
A2-Y1	CN MacMillan		0.6776	
A2-Y2	CN Mimico		0.0015	
A2-Y3	CN Don		0.0059	
A2-Y4	CP Agincourt		0.0398	
A2-Y5	CP Lambton		0.0492	
A2-Y6	CP Obico		0.0012	
A2-Y8	CP Milton		0.0010	
A2-Y9	CP Woodbridge		0.0050	
A2-Y10	CP Belleville		0.0003	

Total Societal Risk for Toronto Area Rail System
= Sum of Societal Risks for all Segments = 2.4 Fatalities/Year

Exhibit 3.30
System Risk By Segment Alternative B2B for 1991

Segment	Subdivision	Length (km)	Societal Risk For Segment (Fatalities/Per Year)	Societal Risk Rate Along Segment (Fatalities/Year-km)
B2B-01	CP Galt	15.6	0.0648	0.00416
B2B-02a	CP Galt	10.1	0.3657	0.03621
B2B-02b	CP Galt	24.2	0.0287	0.00118
B2B-03	CP Galt	2.4	0.0036	0.00150
B2B-04	CP Galt	3.9	0.0076	0.00195
B2B-05	CP Galt/N.Toronto	3.0	0.0265	0.00883
B2B-06	CP N.Toronto	9.1	0.0113	0.00125
B2B-07	CP Belleville	12.5	0.0058	0.00047
B2B-08	CP Belleville	4.6	0.0557	0.00288
B2B-09	CP Belleville	64.3	0.0682	0.00138
B2B-10	CN Oakville	38.0	0.1029	0.00271
B2B-11	CP Canpa	4.2	0.0001	0.000029
B2B-12	CN Oakville	13.4	0.0201	0.00150
B2B-13	CN Weston	9.4	0.0004	0.000043
B2B-14	CN Weston	5.7	0.0282	0.00494
B2B-15	CN Kingston	32.6	0.0055	0.00017
B2B-16	CP Havelock	42.8	0.0007	0.000017
B2B-17a	CN Halton	29.9	0.0844	0.00282
B2B-17b	CN Halton	37.1	0.0015	0.000039
B2B-18a	CN Halton	7.3	0.0555	0.00760
B2B-18b	CN Halton	0.8	0.0066	0.00819
B2B-19	CN Halton/York	6.4	0.0451	0.00700
B2B-22a	CN York	12.0	0.0036	0.00030
B2B-22b	CN York	11.4	0.0050	0.00044
B2B-23	CN Kingston	52.5	0.1061	0.00202
B2B-24	CP MacTier	16.4	0.0060	0.00036
B2B-25	CP MacTier	17.8	0.0092	0.00052
B2B-26	CP MacTier	9.2	0.0031	0.00034
B2B-27	CP MacTier/CN Weston	7.1	0.0339	0.00477
B2B-28	CN Newmarket	44.6	0.0131	0.00029
B2B-29	CN Newmarket	14.2	0.0589	0.00415
B2B-30	CN Bala	21.3	0.0141	0.00066
B2B-31	CN Bala	58.6	0.0437	0.00075
B2B-32	CN Bala	26.4	0.0679	0.00257
B2B-33	CP Owen Sound	57.9	0.0001	0.000003
B2B-34	CN Guelph	13.5	0.0005	0.000037
B2B-35	New	15.1	0.0110	0.00073
B2B-36	New	10.6	0.1022	0.00962
B2B-37	New	9.0	0.0827	0.00918
	Yards			
B2B-Y1	CN MacMillan		0.6776	
B2B-Y2	CN Mimico		0.0015	
B2B-Y3	CN Don		0.0059	
B2B-Y4	CP Agincourt		0.0469	
B2B-Y5	CP Lambton		0.0492	
B2B-Y6	CP Obico		0.0013	
B2B-Y8	CP Milton		0.0013	
B2B-Y9	CP Woodbridge		0.0062	

Total Societal Risk for Toronto Area Rail System
= Sum of Societal Risks for all Segments = 2.3 Fatalities/Year

Exhibit 3.31
System Risk By Segment
Alternative C1 for 1991

Segment	Subdivision	Length (km)	Societal Risk For Segment (Fatalities/Per Year)	Societal Risk Rate Along Segment (Fatalities/Year-km)
C1-01	CP Galt	15.6	0.0407	0.0026
C1-02	CP Galt	34.5	0.0060	0.00017
C1-03	CP Galt	2.4	0.0010	0.00041
C1-04	CP Galt	3.9	0.0032	0.00082
C1-05	CP Galt/N.Toronto	3.0	0.0411	0.0137
C1-06	CP N.Toronto	9.1	0.0123	0.0013
C1-07	CP Belleville	12.5	0.0067	0.00053
C1-08	CP Belleville	4.6	0.0028	0.00060
C1-09a	CP Belleville	51.6	0.0080	0.00015
C1-09b	CP Belleville	12.7	0.0105	0.00083
C1-10	CN Oakville	38.0	0.1180	0.0031
C1-11	CP Canpa	4.2	0.0110	0.0026
C1-12	CN Oakville	13.4	0.0201	0.0015
C1-13	CN Weston	9.4	0.0004	0.00004
C1-14	CN Weston	5.7	0.0282	0.0049
C1-15	CN Kingston	32.6	0.0055	0.00017
C1-16a	CP Havelock	22.7	0.0000	0.0000
C1-16b	CP Havelock	20.1	0.0038	0.000019
C1-17a	CN Halton	23.1	0.0653	0.0028
C1-17b	CN Halton	17.7	0.0667	0.0038
C1-17b	CN Halton	24.8	0.0011	0.000043
C1-18	CN Halton	7.6	0.0003	0.00003
C1-19	CN Halton/York	9.0	0.0019	0.00021
C1-20	CN York	7.3	0.0094	0.0013
C1-21	CN York	8.0	0.0017	0.00021
C1-22	CN York	23.4	0.0001	0.000004
C1-23	CN Kingston	52.5	0.0037	0.000070
C1-24	CP MacTier	16.4	0.0051	0.00031
C1-25	CP MacTier	14.6	0.0027	0.00018
C1-26	CP MacTier	9.2	0.0073	0.00080
C1-27	CP MacTier/CN Weston	7.1	0.0568	0.0080
C1-28	CN Newmarket	44.6	0.0154	0.00034
C1-29	CN Newmarket	14.2	0.0589	0.0041
C1-30	CN Bala	21.3	0.0141	0.00066
C1-31	CN Bala	62.0	0.0421	0.00068
C1-32	CN Bala	22.9	0.0590	0.0026
C1-33	CP Owen Sound	57.9	0.0001	0.000003
C1-34	CN Guelph	13.5	0.0005	0.00004
C1-38	New	61.5	0.0384	0.00062
C1-39	New	8.8	0.0255	0.0029
C1-40	New	24.3	0.0223	0.00092
C1-41	New	22.2	0.0073	0.00033
	Yards			
C1-Y1	CN MacMillan		0.0244	
C1-Y3	CN Don		0.0066	
C1-Y5	CP Lambton		0.0492	
C1-Y8	CP Milton		0.0001	
C1-Y11	CP Bolton		0.0068	
C1-Y12	CN Cherry		0.0455	
C1-Y13	CN Vandorf		0.0164	

Total Societal Risk for Toronto Area Rail System
= Sum of Societal Risks for all Segments = 1.0 Fatalities/Year

Ehibit 3.32
System Risk By Segment Alternative C3 for 1991

Segment	Subdivision	Length (km)	Societal Risk For Segment (Fatalities/Per Year)	Societal Risk Rate Along Segment (Fatalities/Year-km)
C3-01	CP Galt	15.6	0.0407	0.0026
C3-02	CP Galt	34.5	0.0059	0.00017
C3-03	CP Galt	2.4	0.0010	0.00041
C3-04	CP Galt	3.9	0.0032	0.00082
C3-05	CP Galt/N.Toronto	3.0	0.0411	0.0137
C3-06	CP N.Toronto	9.1	0.0123	0.0013
C3-07	CP Belleville	12.5	0.0067	0.00053
C3-08	CP Belleville	8.7	0.0487	0.0056
C3-09	CP Belleville	60.2	0.0964	0.00016
C3-10	CN Oakville	38.0	0.1180	0.0031
C3-11	CP Canpa	4.2	0.0110	0.0026
C3-12	CN Oakville	13.4	0.0201	0.0015
C3-13	CN Weston	9.4	0.0004	0.00004
C3-14	CN Weston	5.7	0.0282	0.0049
C3-15	CN Kingston	32.6	0.0055	0.00017
C3-16	CP Havelock	41.4	0.0007	0.000017
C3-17a	CN Halton	23.1	0.0653	0.0028
C3-17b	CN Halton	17.7	0.0667	0.0038
C3-17c	CN Halton	24.8	0.0011	0.000043
C3-18	CN Halton	7.6	0.0003	0.00003
C3-19	CN Halton/York	9.0	0.0019	0.00021
C3-20	CN York	7.3	0.0094	0.0013
C3-21	CN York	8.0	0.0017	0.00021
C3-22a	CN York	9.3	0.0001	0.000016
C3-22b	CN York	2.8	0.0002	0.000080
C3-22c	CN York	11.3	0.0002	0.000018
C3-23	CN Kingston	52.5	0.1050	0.0020
C3-24	CP MacTier	16.4	0.0051	0.00031
C3-25	CP MacTier	17.8	0.0032	0.00018
C3-26	CP MacTier	9.2	0.0073	0.00080
C3-27	CP MacTier/CN Weston	7.1	0.0568	0.0080
C3-28	CN Newmarket	44.6	0.0154	0.00034
C3-29	CN Newmarket	14.2	0.0589	0.0041
C3-30	CN Bala	21.3	0.0141	0.00066
C3-31	CN Bala	62.0	0.0421	0.00068
C3-32	CN Bala	22.9	0.0590	0.0026
C3-33	CP Owen Sound	57.9	0.0001	0.000003
C3-34	CN Guelph	13.5	0.0005	0.00004
C3-42	New	33.5	0.0084	0.00025
C3-43	New	14.5	0.0029	0.00020
C3-44	New	9.5	0.0033	0.00034
C3-45	New	19.1	0.0089	0.00046
	Yards			
C3-Y1	CN MacMillan		0.0244	
C3-Y3	CN Don		0.0066	
C3-Y5	CP Lambton		0.0492	
C3-Y8	CP Milton		0.0001	
C3-Y11	CP Bolton		0.0068	
C3-Y14	CN Maple		0.0455	
C3-Y15	CN Elgin		0.0164	

Total Societal Risk for Toronto Area Rail System
= Sum of Societal Risks for all Segments = 1.1 Fatalities/Year

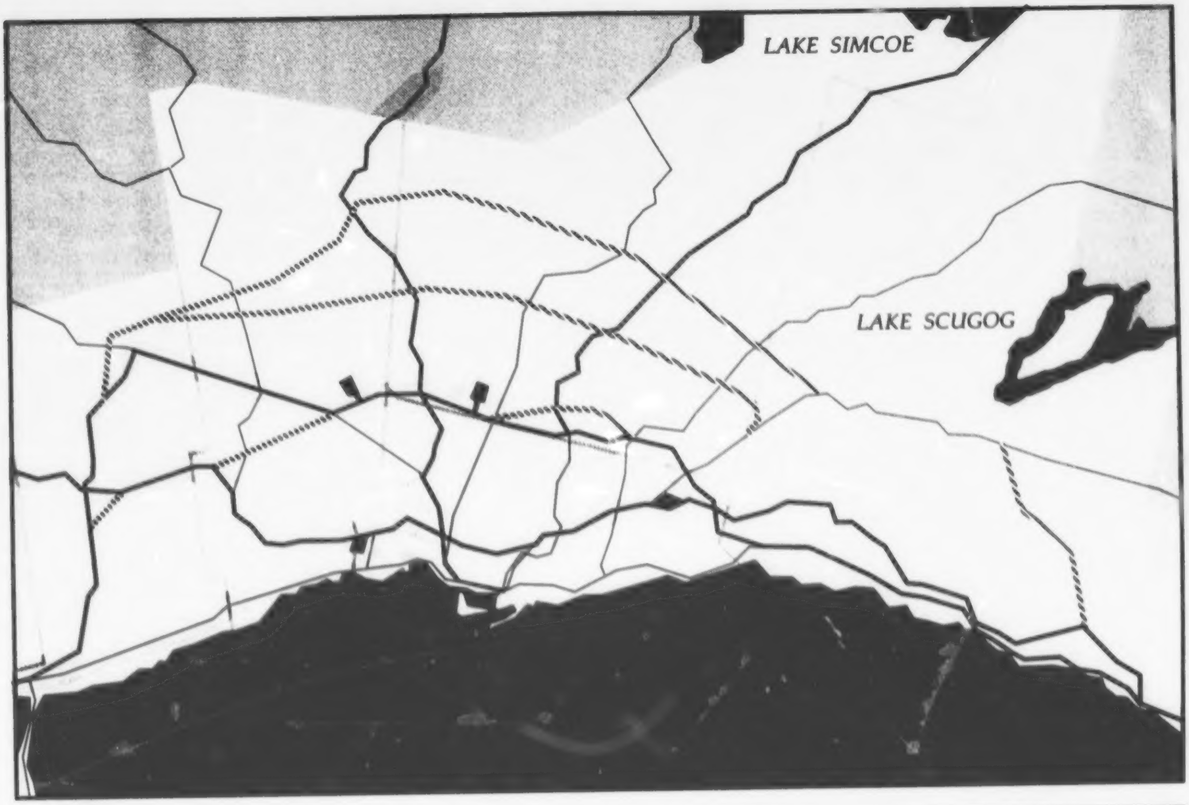


Exhibit 3.33
Societal Risk Distribution-Existing System

Tronçons de lignes ferroviaires

Intervalle des risques estimés en pertes de vie par km par année	Estimated Risk Range in Fatalities per km
$10\times10^{-3} < R < 100\times10^{-3}$	1 every 10 to 100 yrs.
$1\times10^{-3} < R < 100\times10^{-3}$	1 every 100 to 1,000 yrs.
$0.1\times10^{-3} < R < 1\times10^{-3}$	1 every 1,000 to 10,000 yrs.
$R < 0.1\times10^{-3}$	less than 1 every 10,000 yrs.

Yards

Estimated Risk Range in Fatalities per year	Estimated Risk Range in Fatalities
$10\times10^{-3} < R < 800\times10^{-3}$	1 every 1 to 100 yrs.
$R < 10\times10^{-3}$	less than 1 every 100 yrs.

Existing rail system	═
Possible new construction	▨

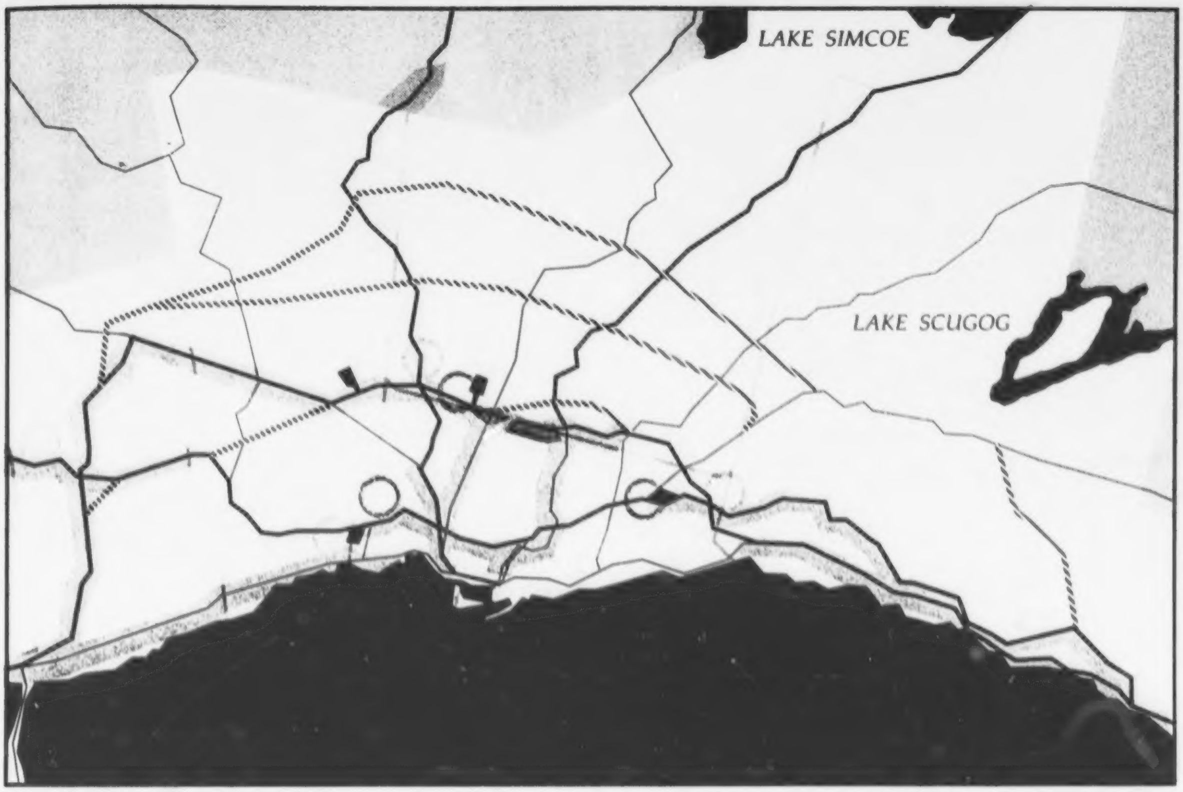


Exhibit 3.34
Societal Risk Distribution-Alternative A2
(1991)

Rail Line Segments

Estimated Risk Range in Fatalities per km per year		Estimated Risk Range in Fatalities per km
$10\times10^{-3} < R < 100\times10^{-3}$	▓	1 every 10 to 100 yrs.
$1\times10^{-3} < R < 100\times10^{-3}$	━	1 every 100 to 1,000 yrs.
$0.1\times10^{-3} < R < 1\times10^{-3}$	─	1 every 1,000 to 10,000 yrs.
$R < 0.1\times10^{-3}$	─	less than 1 every 10,000 yrs.

Yards

Estimated Risk Range in Fatalities per year		Estimated Risk Range in Fatalities
$10\times10^{-3} < R < 800\times10^{-3}$	○	1 every 1 to 100 yrs.
$R < 10\times10^{-3}$	○	less than 1 every 100 yrs.

Existing rail system ═

Possible new construction ⫽⫽⫽⫽

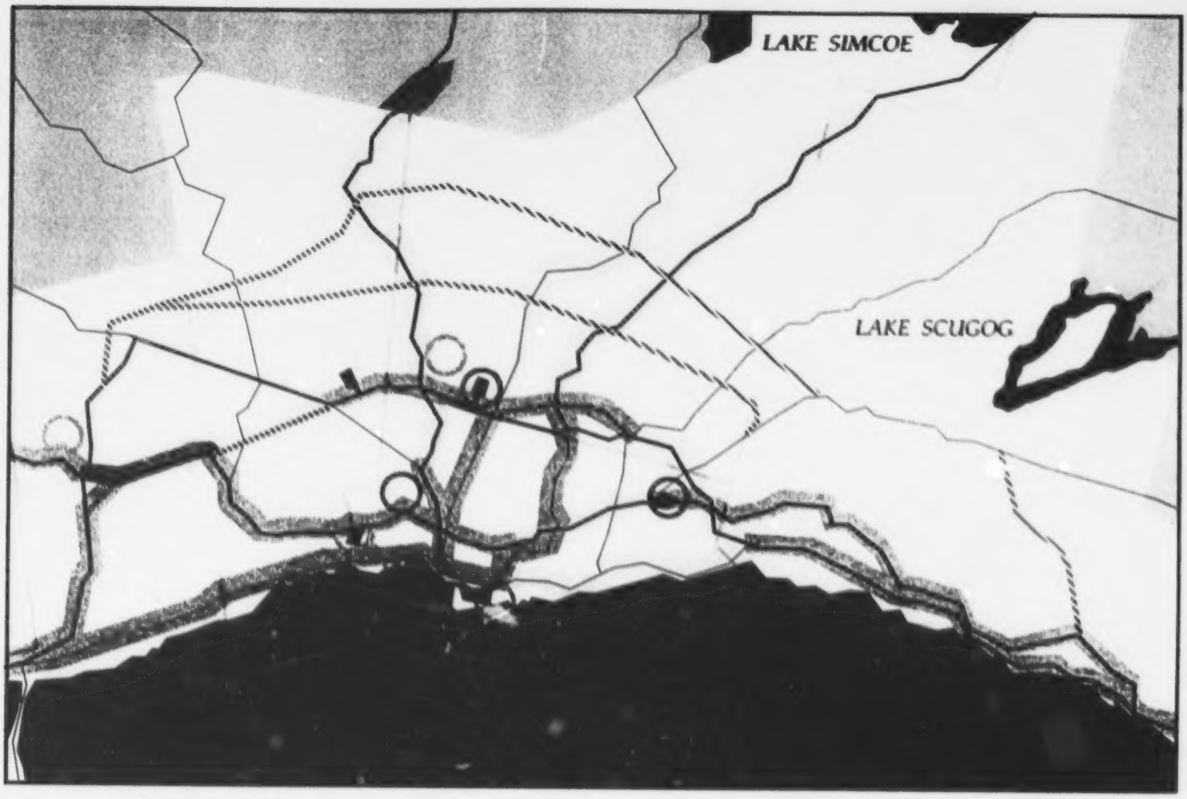


Exhibit 3.35
Societal Risk Distribution-Alternative B2B

Rail Line Segments

Estimated Risk Range in Fatalities per km per year		Estimated Risk Range in Fatalities per km
$10\times10^{-3}<R<100\times10^{-3}$	■	1 every 10 to 100 yrs.
$1\times10^{-3}<R<100\times10^{-3}$	▒	1 every 100 to 1,000 yrs.
$0.1\times10^{-3}<R<1\times10^{-3}$	□	1 every 1,000 to 10,000 yrs.
$R<0.1\times10^{-3}$	□	less than 1 every 10,000 yrs.

Yards

Estimated Risk Range in Fatalities per year		Estimated Risk Range in Fatalities
$10\times10^{-3}<R<800\times10^{-3}$	○	1 every 1 to 100 yrs.
$R<10\times10^{-3}$	◌	less than 1 every 100 yrs.

Existing rail system	═
Possible new construction	▨

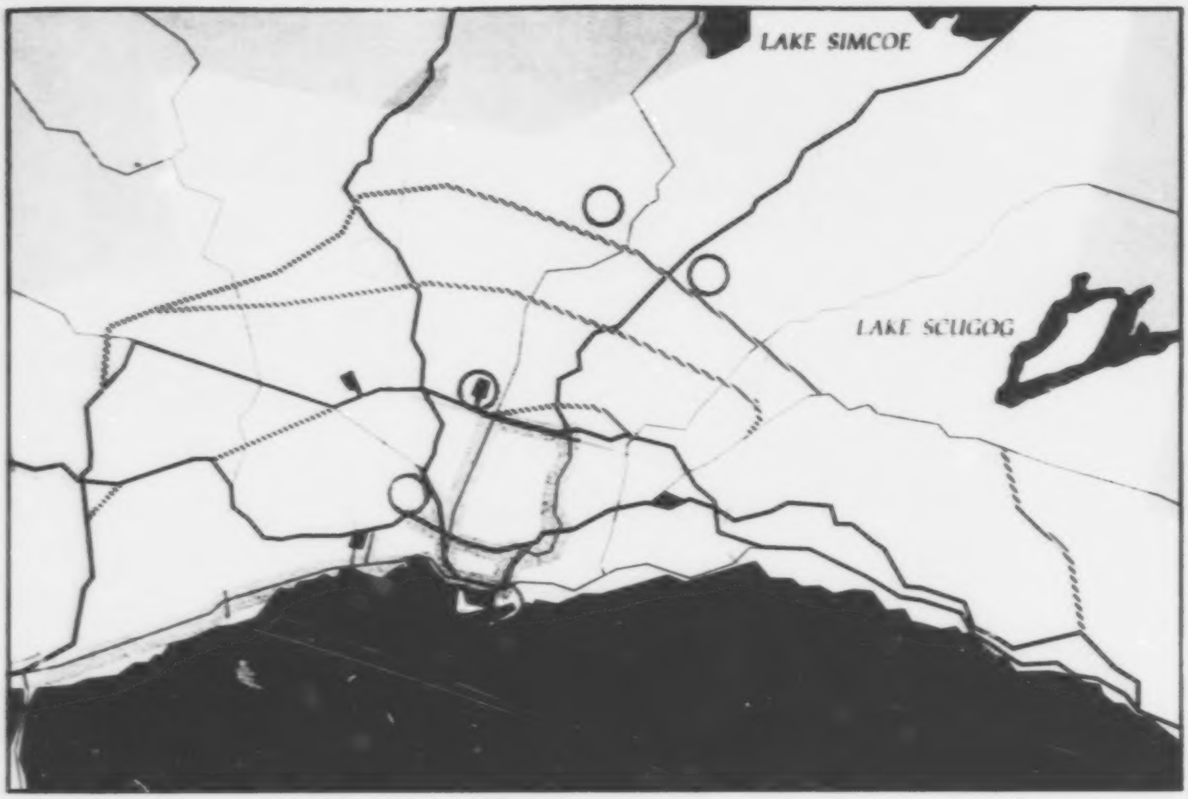


Exhibit 3.36
Societal Risk Distribution-Alternative C1

Rail Line Segments

Estimated Risk Range in Fatalities per km per year		Estimated Risk Range in Fatalities per km
$10\times10^{-3}<R<100\times10^{-3}$	▬	1 every 10 to 100 yrs.
$1\times10^{-3}<R<100\times10^{-3}$	┄	1 every 100 to 1,000 yrs.
$0.1\times10^{-3}<R<1\times10^{-3}$	─	1 every 1,000 to 10,000 yrs.
$R<0.1\times10^{-3}$	┄	less than 1 every 10,000 yrs.

Yards

Estimated Risk Range in Fatalities per year		Estimated Risk Range in Fatalities
$10\times10^{-3}<R<800\times10^{-3}$	○	1 every 1 to 100 yrs.
$R<10\times10^{-3}$	◌	less than 1 every 100 yrs.

Existing rail system	═
Possible new construction	⁓⁓⁓

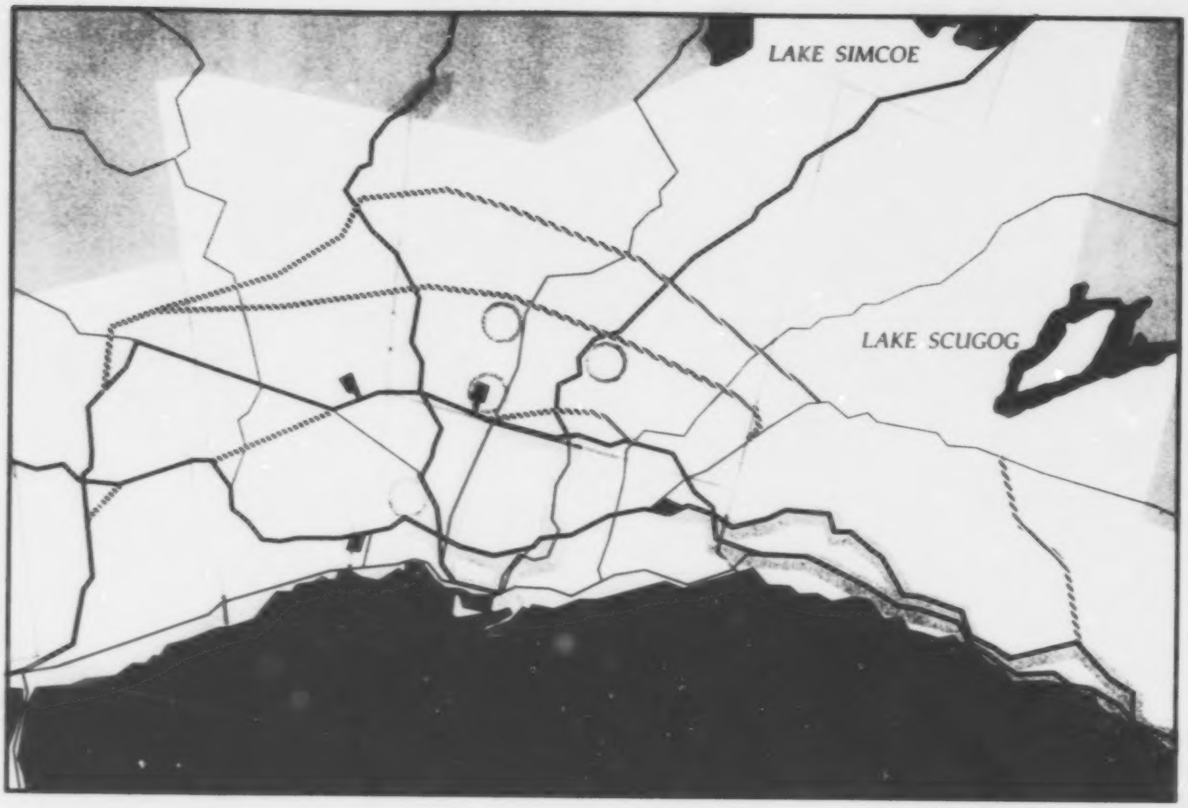


Exhibit 3.37
Societal Risk Distribution-Alternative C3

Rail Line Segments

Estimated Risk Range in Fatalities per km per year		Estimated Risk Range in Fatalities per km
$10 \times 10^{-3} < R < 100 \times 10^{-3}$	▬	1 every 10 to 100 yrs.
$1 \times 10^{-3} < R < 100 \times 10^{-3}$	━	1 every 100 to 1,000 yrs.
$0.1 \times 10^{-3} < R < 1 \times 10^{-3}$	─	1 every 1,000 to 10,000 yrs.
$R < 0.1 \times 10^{-3}$	┄	less than 1 every 10,000 yrs.

Yards

Estimated Risk Range in Fatalities per year		Estimated Risk Range in Fatalities
$10 \times 10^{-3} < R < 800 \times 10^{-3}$	○	1 every 1 to 100 yrs.
$R < 10 \times 10^{-3}$	○	less than 1 every 100 yrs.

Existing rail system ═

Possible new construction ≈≈≈

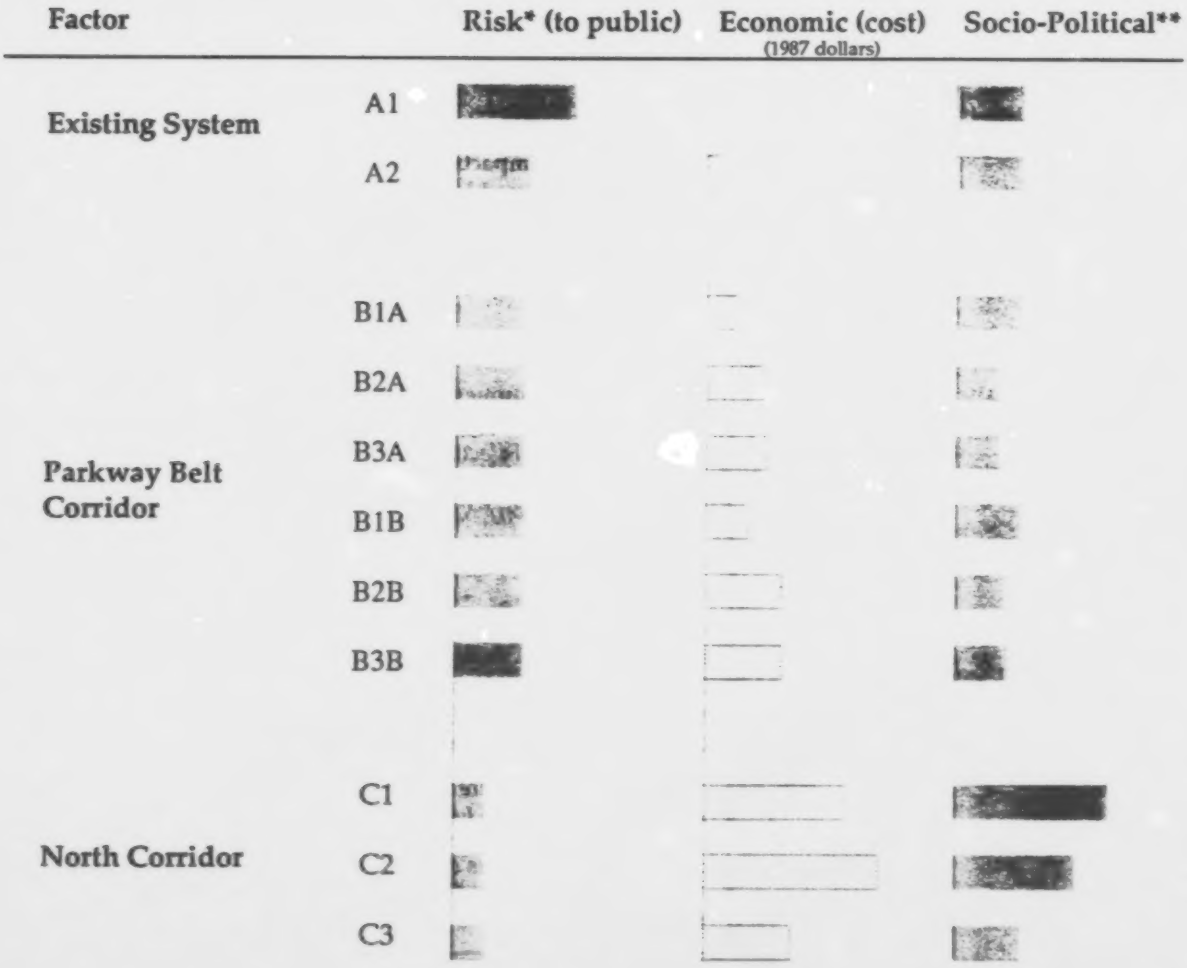
fore that it is appropriate to continue using the above figures throughout our Report.

3.8.D Routes and Risk Findings Summarized

Our evaluation criteria have, to this point, only served to indicate the complexity of the situation. They indicate that rerouting and relocation options in the Greater Toronto Area are indeed possible from an engineering, technical and operational point of view; that these reroutings will cause some social and environmental disruption; and that the costs of carrying them out varies quite substantially. They also

Exhibit 3.38 Graphic Evaluation Indices for Alternative Routings and Operational Strategies

**Average of Risk Estimate for 1991 and 2011.*
***Includes community and natural environmental impacts averages for 1991 and 2011.*
The longer the bar, the larger the estimated impact. The bars can only be compared within each vertical column.



indicate that risk reductions, both on a societal, system wide basis and on an individual segmental basis as well, could be achieved.

Exhibits 3.38 and 3.39 summarize and consolidate our evaluation criteria findings.

We further analyzed the risks in relationship to costs and determined that several alternatives achieved a similar system-wide, societal risk reduction but at varying levels of cost (see Exhibit 3.40). It seemed to us however, that while some

Exhibit 3.39
Evaluation Indices for Alternative Routes and Operating Plans

1.0 Safety Impacts
1.1 Societal Risk 1991 (average yearly fatalities)
1.2 Societal Risk 2011 (average yearly fatalities)

2.0 Community Impacts
2.1 Loss of Developed Land (km)
2.2 Loss Developable Land (km)
2.3 Loss of Farm Land (km)
2.4 Community Barrier Effects (km)

3.0 Natural Environment Impacts
3.1 Noise and Vibration Exposure (people)
3.2 Visual Impact Effects (km)
3.3 Water Quality/Aquatic Life Effects (crossings)
3.4 Spec. Vegetation/Wildlife Area Effects (km)

4.0 Economic Effects
4.1 Capital Cost ($ million)
4.2 Operating Costs (capitalized) ($ million)
4.3 Impact on Planned Commuter Service ($ million)
4.4 Buffers ($million) *Refer to section 3.12*

** Capital costs shown are net of estimated return from sale of existing rail yards. Operating cost/savings have been capitalized over fifty years
Numbers in brackets denote potential cost reductions rather than costs. Actual cost reductions from impacts on rail commuter service would depend on negotiations between the railways and Go Transit if improved commuter services were to be implemented.*

preliminary judgements could be made on this basis, we had several other considerations to weigh before reaching any definite conclusions.

Existing System		Parkway Belt Corridor						North Corridor		
A1	**A2**	**B1A**	**B2A**	**B3A**	**B1B**	**B2B**	**B3B**	**C1**	**C2**	**C3**
4.1	2.4	2.5	2.5	2.5	2.3	2.3	2.3	1.0	1.0	1.1
4.6	3.3	3.0	3.0	3.0	2.9	2.9	2.9	1.5	1.5	1.7
0.0	0.0	12.5	12.5	12.5	16.0	16.0	16.0	6.5	6.5	1.5
0.0	0.0	1.5	1.5	1.5	6.5	6.5	6.5	3.0	3.0	5.5
0.0	0.0	14.0	14.0	14.0	24.0	24.0	24.0	121.5	121.5	89.0
219.3	219.3	219.4	146.5	146.5	194.7	122.3	122.3	119.8	41.3	92.5
1,199	1,999	1,112	530	530	1,067	484	484	499	79	584
0.0	0.0	4.0	4.0	4.0	7.0	7.0	7.0	52.0	52.0	24.0
369	320	331	331	331	344	344	344	285	285	299
19.5	19.5	16.5	12.0	12.0	16.5	12.0	12.0	89.0	57.0	14.0
0	54	372	615	758*	612	823	966*	1,000*	1,581*	725*
0	142	(29)	115	(7)	(29)	115	(7)	657	484	325
0	0	(55)	(130)	(130)	(72)	(147)	(147)	(108)	(162)	(107)
								300	to	500

3.9 The North Corridor Option
(The 'C' Alternatives)

The existing system and the Parkway Belt are relatively known entities, having been in existence for some time. The North Corridor is however new. We want to take this opportunity to describe it in some detail before proceeding.

The North Corridor is an area of land approximately 15 km wide lying between the outside limits of urban development to the year 2011 in the South, and the southerly edge of the rolling and rough terrain in the North. Within this strip of land, we developed two possible rail scenarios and one further sub-option. (The sub-option (Alternative C-2) was

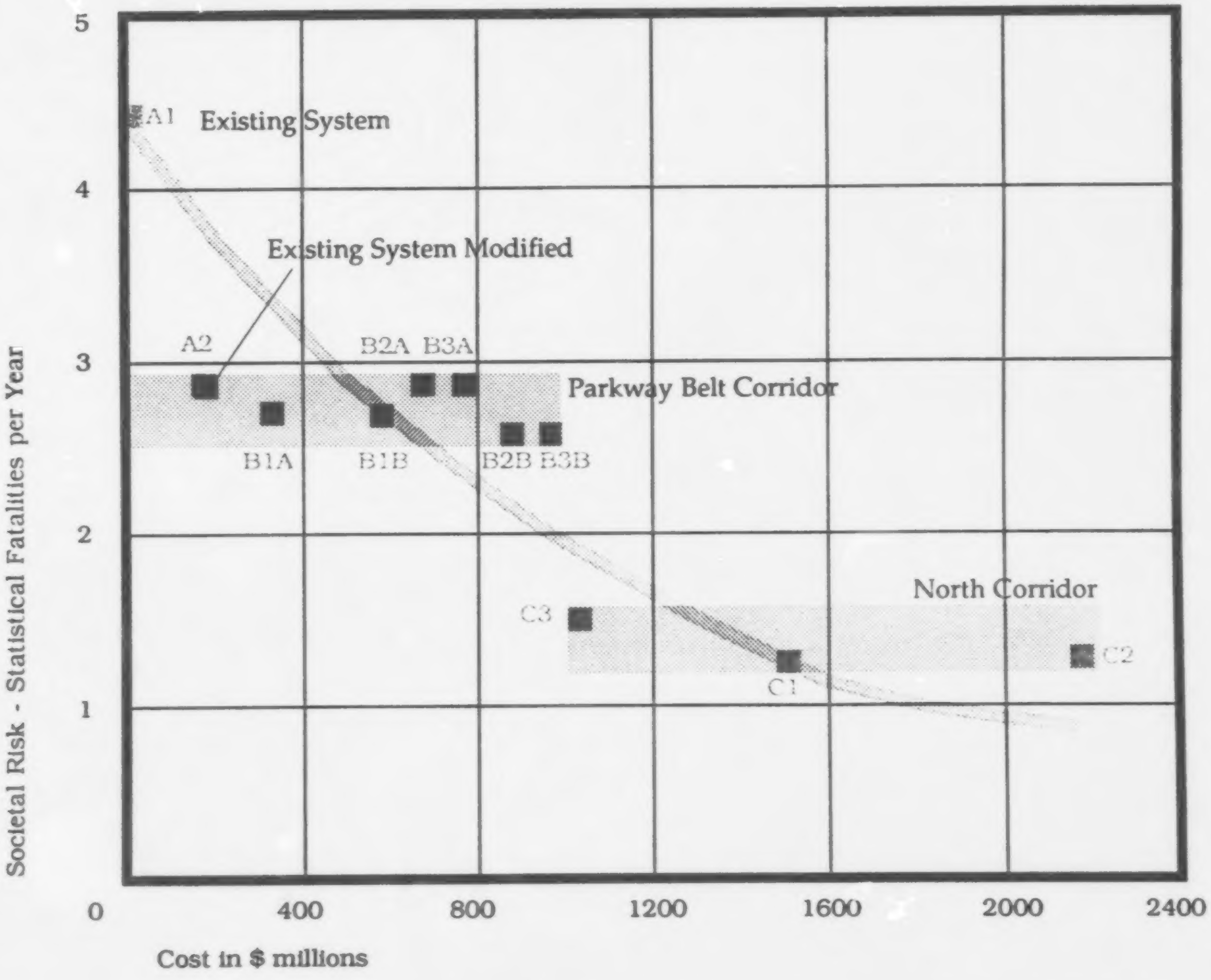


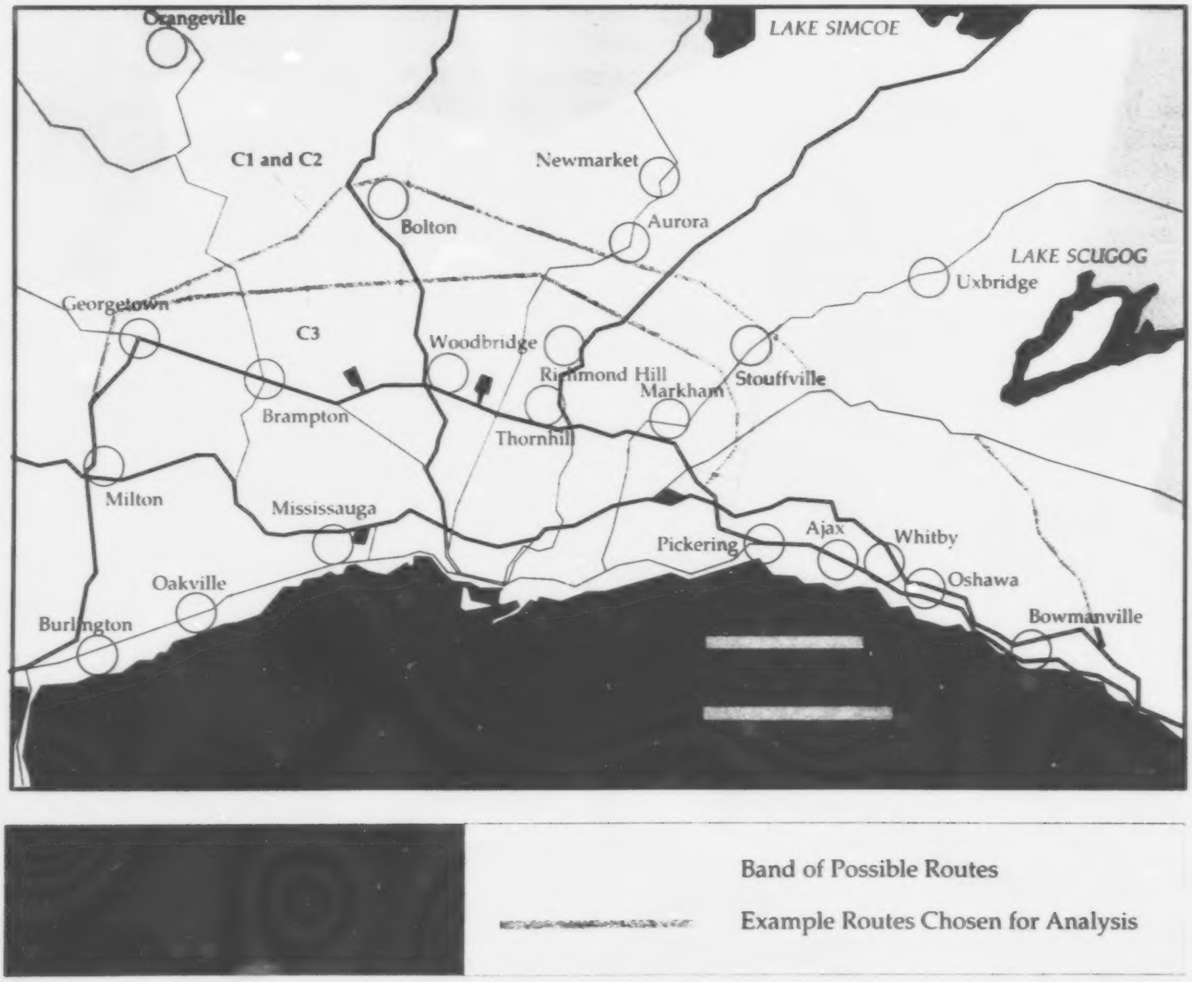
Exhibit 3.40
Risk vs Cost

▨ Risk Similarities

▨ General Risk Cost Curve (risk values have been averaged between 1991 through 2011) actually the same rail route as Alternative C-l, but with a different traffic configuration passing over it.)

Sufficient information was developed on these lines for costing and risk analysis. There are possibly many more combinations and routing configurations available, but the three outlined below were sufficient for our purposes (refer to Exhibit 3.41).

The North Corridor options are indeed feasible. The capital costs ranged from $725 million (in 1987 dollars) for the more southerly (C-3) option to $1.686 billion for the more northerly (C-2) option. Incremental annual operating costs range from $17.8 million for option C-3 to $36.0 annually for option C-1. The above costs do not include the cost of additional buffering lands. We will discuss this aspect in more detail shortly.


Orangeville
LAKE SIMCOE
C1 and C2
Newmarket
Bolton
Aurora
LAKE SCUGOG
Uxbridge
Georgetown
C3
Woodbridge
Richmond Hill
Markham
Stouffville
Brampton
Thornhill
Milton
Mississauga
Pickering
Ajax
Whitby
Oshawa
Oakville
Burlington
Bowmanville
Band of Possible Routes
Example Routes Chosen for Analysis

The North Corridor options yielded risk reductions of about 75 per cent over the existing system (from 4.1 to 1.0 possible fatalities per year). However, risk values for these options would increase by 55 per cent between 1991 and 2011, compared to 12 per cent for the existing system. This is solely due to projected population growth in the area. Thus the maximum 75 per cent risk reduction in 1991 for a North Corridor would in fact be reduced to a 67 per cent risk reduction in the year 2011, when a new system might be fully operational.

Our estimates of development into the more northerly Regions of the Greater Toronto Area indicate that North Corridor options are already constrained where they cross Yonge Street just north and south of Oak Ridges. Indeed, these are the only two open land opportunities left for a major east/west transportation corridor in the north of the Greater Toronto Area.

Every northern community and their respective Regional Government voiced great concern about the need to recognize this rapid development, and the dangers of "imposing the risk of today on the population of tomorrow". The Urban Development Institute (Ontario), representing the major developers in the area, voiced strong concern that our particular 15 kilometre area of land should not be left as an open-ended question. They indicated that such an approach would invariably restrict planning for the whole area until more firm decisions could be made.

While we did not examine the following in detail, we believe an opportunity also exists for combining both the preferred southerly North Corridor option (C-3) with the more easterly portion of the northern route alternatives (C-1 and C-2). This modification would provide the residents of Durham with some additional risk reduction possibilities.

Canadian National's Kingston Subdivision in the Region of Durham is bordered on its south side by some residential and industrial development, but it benefits from the presence of Highway 401 acting as a buffer on its north side. The same however cannot be said for the Canadian Pacific's Belleville Subdivision track. The residents of Durham would benefit by the use of the more northerly C1 and C2 options instead of the existing system. An almost 80 per cent risk reduction on the Canadian Pacific line could be achieved in 1991 but this would be reduced to 17 per cent by 2011, due to population growth. The risk reduction benefit on the Canadian National line in both 1991 (96 per cent) and 2011 (78 per cent)would be more substantial.

The same option of further diverting Canadian Pacific's dangerous goods rail traffic off its Belleville Subdivision exists for both the more southerly North Corridor option (C-3) and for the Parkway Belt Corridor options. In the latter case, the object would be to divert Canadian Pacific's dangerous goods traffic which currently runs through Pickering, Ajax, Whitby, Bowmanville and Oshawa on the Belleville Subdivision. This diversion would be by means of an inter-railway connector east of Bowmanville, with the diverted traffic running on Canadian National's Kingston Subdivision on a joint use basis.

3.10 Other Considerations

Various groups expressed concern that rerouting alternatives might have serious and adverse implications for the manufacturing and industrial base of the Greater Toronto Area, and that public safety might be jeopardized by the possible transfer of more dangerous goods onto the road transportation system.

3.10.A Industrial Base Implications

The Canadian Manufacturers Association, the Canadian Industrial Transportation League, Associations representing the chemical, fertilizer, petroleum and gas industries, and several Boards of Trade argued that industry is willing to be a good and responsible corporate citizen, but that it must be convinced that a problem exists and that all the costs and benefits are properly tallied.

We discussed the issue of rerouting the rail flow of dangerous goods in the Greater Toronto Area with a representative sample of manufacturers and receivers. These industries have built facilities to accommodate the rail mode, and are concerned about the cost and disruption that would be involved if these had to change. All expressed a genuine desire to act responsibly, within reasonable means, and we are grateful for their frank and instructive advice.

We concluded early in our deliberations that rerouting would not affect the industrial base of the Greater Toronto

Area. In fact, we stated explicity from the outset that the existing rail network would, and should, be kept in place to accommodate 'local' freight and 'local' dangerous goods traffic.

We realized however that some disruption in delivery and pickup practices may occur if rerouting significantly altered railway operations, efficiencies and economics. The railways themselves are, of course, vitally interested in servicing their customers, and this aspect, along with safety, is of major importance to them.

As previously stated, we worked closely with the railways to develop operational plans that were practical and achievable. Because of their assistance, and because the existing system would be retained for local dangerous goods and other freight movements, we are convinced that the industrial and manufacturing base of the Greater Toronto Area would not be unduly disrupted by our rerouting options.

3.10.B Modal Shift from Rail to Truck/Road Transportation System

While the study of dangerous goods transportation by truck was not in our mandate, we were asked to determine if any rerouting or relocation option would have an impact on the highway mode.

A recent Transport Canada study concluded that it is too difficult to make a clear and unequivocal statement as to which mode is safer, truck or rail. But our concern is not to pass judgement on the relative safety of trucks. It is solely to determine whether significant volumes of dangerous goods traffic would shift from rail to trucks under our rerouting options.

The industrial/ manufacturing base has already been developed to accommodate rail. Most of the dangerous goods traffic in Greater Toronto is 'through' traffic, and existing trackage would remain to cater to local rail traffic. Assuming that the economics of the situation would not cause rail shipping costs to rise unduly, the movement to trucks from rail, especially in our Parkway Belt Corridor options, would be minimal. As the options move northwards and the costs increase substantially, the shift to trucks becomes more difficult to predict, but it is clearly more likely to occur within the North Corridor options.

3.10.C Railway-Road Competition

In addition to the safety implications, the possibility of a shift of dangerous goods traffic from rail to trucks caused by rerouting or relocating also has economic ramifications. No action should be taken which would inadvertently throw the competitive positions of the rail and trucking industries off balance, thereby endangering one or the other as a viable economic alternative.

We believe that the rail industry is a relatively safe industry, and that it strives to improve safety at all times. We also believe that some dangerous products which need to be transported in large quantities are best carried by rail. According to our public perception survey the general public agrees, and feels that the railways are performing well and responsibly. Even the Ontario Trucking Association did not advocate a shift of dangerous commodities from rail to trucks.

We conclude that the economic competition between the two industries should be nurtured and encouraged. Furthermore, we note that an improved competitive position for the rail industry could help to enhance its safe rail operation. We are impressed by the way the U.S. rail safety record increased after deregulation. While there are no studies which establish a definitive link between improved safety and deregulation, the improvement has nevertheless occurred. And many people feel that it can be accounted for, at least in part, by the fact that as the railways become more competitive, they are more willing to devote resources to improve standards of operation and equipment, in addition to the fact that with more revenues, they are able to devote more financial resources to upgrading their infrastructures.

A vital, economically-viable rail system is required for the safe transportation of dangerous goods, and we believe steps should be taken to enhance this economic vitality. There are opportunities to reduce the regulatory burden on Canada's railways, to encourage joint use and facility sharing, and to rationalize the rail network in the Greater Toronto Area.

Such improvements in railway economics would, we believe, lead directly to improved safety in the transportation of dangerous goods. We will return to this point shortly.

3.11 Route Alternatives - Conclusions and Recommendations

3.11.A
The Existing System

The 'relative' risk involved in the rail transportation of dangerous goods in the Greater Toronto Area (4.1 statistical fatalities/year) is in our judgement low when compared to that of other risks we encounter every day — in 1985, there were 4,238 road fatalities in Canada. (In absolute risk terms, our consultants advise us that the risk would more likely be about one third of the relative risk figure, or about 1.4 statistical fatalities per year.) Having reviewed the evidence, therefore, our considered opinion is that the present rail system in the Greater Toronto Area is relatively safe.

True, there are segments of the existing system where the risk is a great deal higher than others. Given this, however, all but one member of the Task Force believe there is still not sufficient justification to relocate or reroute this overall system to lower this segmental risk alone.

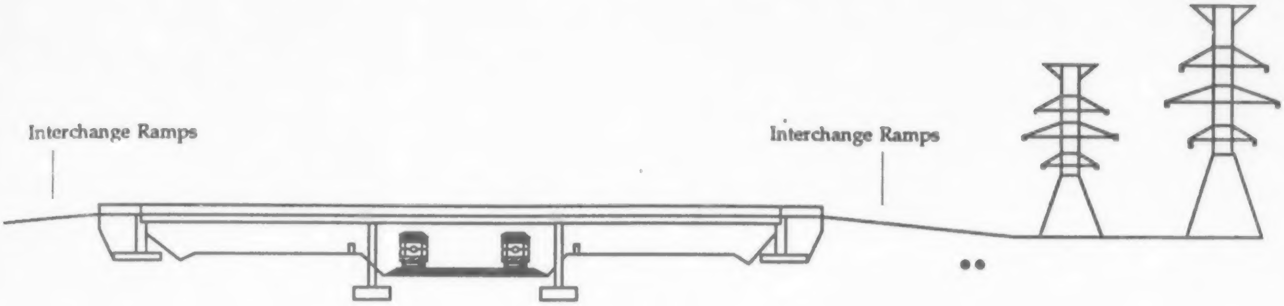
We will be addressing safety improvements to the existing system in a later part of this Report. We believe that improvements can be implemented in a relatively short period of time; that they will be of assistance in reducing the probability of a dangerous goods rail accident; and that the public's confidence in the safety of the railway system will increase.

We therefore have concluded that the Existing System is relatively safe; improvements can, and should be made to it; but that the present risk potential alone is not sufficient reason for proceeding with a rerouting or a relocation of the railway system. (It should be noted that not all members of the Task Force are in agreement with this latter statement. There is one member of the Task Force who feels that segmental risk on some subdivisions are high and that as such the risks do justify the relocation of the rail system.)

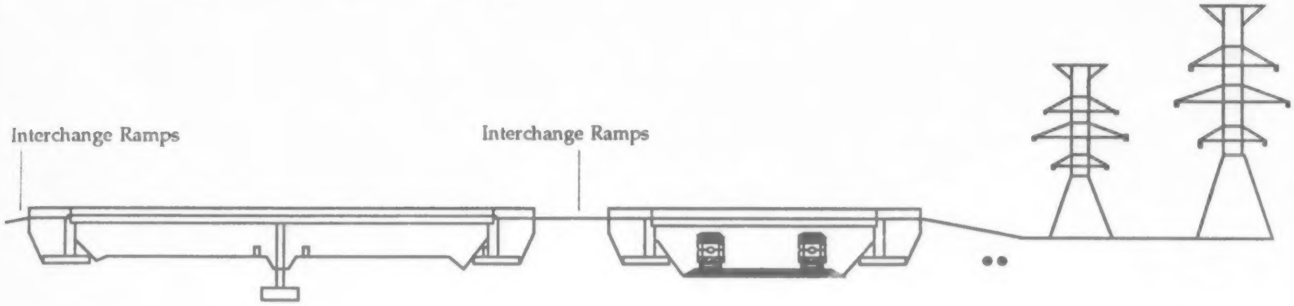
3.11.B Railway Rationalization (Involving the Parkway Belt)

As stated above, the majority of the Task Force is strongly of the opinion that rerouting and relocation can not be justified on the basis of dangerous goods volumes and risk alone. But they have also concluded that if rerouting is justified, it could be on the basis of not only risk reduction but also on the economic benefits found in the context of a total rail rationalization in the Greater Toronto Area.

As also previously stated, we recognize that Rail Rationalization not only involves the use of a route or a combination of routes but involves other considerations as well. However, the Task Force was most impressed with the options provided by the Parkway Belt which, along with the Canadian National's York Subdivision, could provide the necessary capacity to accommodate both railways' east-west freight traffic



Concept 1 at Road Crossing



Concept 2 at Road Crossing

Exhibit 3.42
Conceptual Hwy 407 and Rail Corridor Co-existing Within Parkway Belt

●● Utility Corridor

flows. Also one western section of the Parkway Belt provides the opportunity for reduced track mileage (which in turn generates cost savings), while providing a buffering opportunity in the case of a dangerous goods accident. In the central area of the Parkway Belt, some additional track capacity appears possible, and reasonable buffering is available here also.

We recognize the Province of Ontario's concerns that the Parkway Belt was not developed to include a major railway system. Our preliminary engineering advice, however, indicates that the development of rail capacity in the Parkway Belt is possible along with other utilities and the future Highway 407. Exhibit 3.42 shows a concept for accommodating rail lines in association with Highway 407.

We were most impressed with the Province of Ontario's submission to the Task Force in which it was suggested that attempts should be made to improve the high risk segments in the existing system. We are also aware of the benefits which could accrue to the Province through the future GO Commuter system options under a rail rationalization study. We were further impressed, in particular, with the comments of the Honourable Ian Scott MPP, in his address to us, in which he re-affirmed the Province's cooperation in seeking and arriving at solutions.

The buffering features of the Parkway Belt, which we will discuss in more detail, do provide a greater measure of protection than do those areas where development now exists right along the tracks. This situation exists in downtown Toronto as well as in Thornhill, Markham and Vaughan.

Common use of rail lines by Canadian Pacific and Canadian National would require some form of joint management or administration. The concept of a 'Joint Railway Agency' through which there would be joint use of track and railway infrastructure should also be addressed in any railway rationalization. It goes without saying that this new joint-use facility should incorporate 'state-of-the-art' technology and infrastructure in the interest of public safety. We believe that a rationalized rail network could provide the opportunity to make the total system as safe as possible, and at the same time could provide real economic benefits to both railways.

These economic benefits will assist in meeting another concern which was repeatedly expressed to us - that being the maintenance of a safe, competitive rail system so that a modal shift of dangerous goods to truck, will not result..

We therefore strongly recommend that:

- **A team, consisting of representatives from the Minister of Transport, the Province of Ontario and the two major railways, be immediately established to:**
  - **☐ Prepare a plan for the rationalization of the rail systems through the affected area;**
  - **☐ Quantify the economic advantages of such a system;**
  - **☐ Provide detailed capacity and operational requirements;**
  - **☐ Advise on a type of Joint Use Agency equitable to all parties and suitable for the management of operations in this Joint Use territory; and**
  - **☐ Provide a detailed implementation strategy.**
- **Contingent on rail rationalization, the Parkway Belt Corridor options be considered as providing the best rerouting and relocation opportunity in the Greater Toronto Area;**
- **The Parkway Belt option (BIB), which diverts danger-**

ous goods into the Belt (thus providing buffering as an increase to public safety for present development), while using the present Canadian National Railways' York Subdivision for general, non-dangerous freight traffic be considered most advantageous;

- **The Province of Ontario be requested to retain provision for a mainline rail facility in the Parkway Belt in conjunction with its development, planning and construction of other facilities;**
- **In conjunction with the Municipalities, the Rail Rationalization Team be asked to identify, as quickly as possible, those areas along the existing and Parkway Belt segments where additional buffers can be provided through zoning, compatible with rail operations;**
- **The Province of Ontario, in conjunction with the Municipalities, be requested to zone those lands, identified above, accordingly; and**
- **The Rail Rationalization Team should also give consideration to the joint use of Canadian National's Kingston Subdivision for the rail movement of dangerous goods in the Regional Municipality of Durham.**

It should be noted, of course, that any rationalized rail system in the Greater Toronto Area should not compromise the railways' ability to meet present and future market demands.

3.11.C The North Corridor Options - (The 'C' Alternatives)

The Task Force wishes to see the North Corridor options (and particularly the more southerly option (Alternative C-3)) remain as a viable alternative.

Should the Parkway Belt Corridor recommendation prove too difficult to implement, or a future longer term 'second Parkway Belt corridor' be needed to handle the Greater Toronto Area growth into the 21st Century, the North Corridor options should be considered.

In the case of a new Corridor in the North, land would either have to be zoned by the Province of Ontario, with the full co-operation of all the Municipalities, or it would have to be acquired by the railways or the Federal Government. As mentioned, developers and the Municipalities in the area are particularly concerned about the freezing of entire tracts of land, pending a decision on whether, and where, a new corridor would be built.

It would be a tremendous task to acquire a new rail right-of-way, well protected by buffers to avoid the encroachment problems and erosion of public confidence that has occurred in the past. The Province of Ontario is, in the interest of public safety, prepared to cooperate in this regard. The fact remains, however, that the Parkway Belt experience in Ontario, the utility corridor experience in Edmonton and the rail relocation endeavours in Regina show that the implementation of public transportation corridors requires a great deal of cooperation from all levels of Government and from the private sector as well.

In order to reduce uncertainty, and because of the Yonge Street development impacting on the limited corridor opportunities now existing (complicated by the rapid developmental pressures in north Greater Toronto). We urge immediate steps in this area.

We therefore recommend that:

- **As a matter of urgency, the Minister of Transport, along with the Province of Ontario and the railways, undertake a review of the necessary preliminary actions required for determining and developing a transportation/utility corridor in the north of the Greater Toronto Area; and that**
- **In reviewing the North Corridor, the more southerly North Corridor Option (Alternative C-3) be considered the preferred option.**

3.12 Buffers

3.12.A General

As stated earlier, an incompatible (although still relatively safe) situation now exists between many residential communities and the railway system transporting dangerous goods caused by the encroachment of development along rail lines.

While we appreciate that past actions were taken given the circumstances and the knowledge available at the time, we are shocked to see the same encroaching situation occurring today. Even in the City of Toronto, rezoning and incompatible land uses have been allowed to take place since the Mississauga derailment in 1979. We toured the developing areas in the more northern Regions of the Greater Toronto Area. We saw housing being built right along existing trackage with no protection for residents in the case of a dangerous goods spill, and no effective means of access to the rail lines for emergency crews in the case of an accident.

We heard from many individuals, ratepayers' Associations, elected officials, industry representatives and experts on this subject. For example, the Fire Chief of the Town of Vaughan indicated that access to the rail lines was most difficult in his jurisdiction; that houses were being built exceedingly close together; and that access to the water supply to fight any major rail fire was inadequate. (We will discuss the need for an adequate emergency preparedness and response capability later in this Report.)

Should the rail rationalization previously mentioned prove it feasible to reroute and/or relocate the rail flow of dangerous goods in the Greater Toronto Area, there should be some mechanisms to ensure that the encroachment practices of the past do not occur again in the future. This is important not only to protect the large economic investment involved, but more importantly to maintain public safety and protect residents living near rail lines.

We commissioned our consultants to examine this issue in detail, and devoted considerable time to the subject ourselves. We questioned representatives of foreign countries on their use of buffering mechanisms, and learned that no concerted buffering effort is being taken elsewhere. We learned that the use of buffers in the United States is not an issue, and that relocations are not contemplated to deal with the problem of encroachment. Canada appears to be in the forefront in this regard.

3.12.B The Issues

Our examination of the topic uncovered many interesting issues. With respect to Municipal governments, there was:

- A limited awareness of the issue; while awareness was increasing in some Municipalities, it was not a high priority;
- A major need for tax revenues to provide the infrastructure and services to handle the growth and pressures for increased zoning in the area;
- A stiff competition between Municipalities for new development; and
- A real feeling of vunerability in the face of enormous development pressures, especially in the absence of recognized guidelines on buffering related to dangerous goods from senior levels of Government.

We learned that the railways do act responsibly and have taken reasonable steps to improve safety. They consider themselves responsible only for actions within their own rights-of-way, and cannot economically justify expanding these rights-of-way and remain competitive. The railways feel that the Municipalities have not been consistent in dealing with encroachment, and therefore should assume some responsibility for the present situation.

From a Provincial and Federal Government perspective, we learned that:

- The Federal Government regulates the railways within the rail right-of-way whereas the Province of Ontario regulates the use of land outside that right-of-way;
- The Province of Ontario, while issuing guidelines to mitigate noise and vibration, feels that safety is the responsibility of the person or organization creating the unsafe situation; and
- The Federal legislation governing airports, the Aeronautics Act, is used to ensure the safe operation of aircraft, and in effect controls the use of land surrounding airports.

Encroachment has already developed along the existing system for many years. To implement a buffering concept along this network is impossible. We are convinced, however, that buffering is possible in areas not yet filled-in along the existing rail lines, within the Parkway Belt, and along any new line constructed in the future. In existing corridors, as redevelopment occurs on adjacent lands there is an opportunity to ensure more compatible land uses.

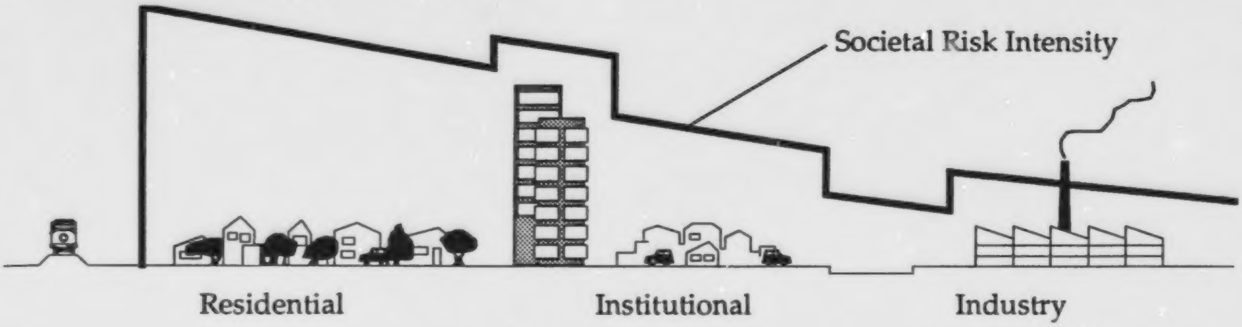
3.12.C Mitigative Measures

We studied various buffering measures, from open space 'setbacks' to physical barriers such as walls, berms and ditches. We also looked at the use of lands between the railways and more sensitive land uses, such as hospitals, schools, senior citizen accommodations, and high density establishments.

Sterile land setbacks, of an appropriate width, would be prohibitively expensive and therefore impractical. Our studies also show that walls, berms and ditches were not effective against clouds of toxic gases, or BLEVEs (Boiling Liquid Evaporating Vapour Explosions).

However, we are convinced that setback lands could be developed for compatible uses, such as industry, agriculture, parks, and the like. Exhibit 3.43 illustrates the difference between sensitive land use development along lines without buffers and more compatible development along the same lines, within a properly-zoned setback area. Exhibit 3.44

Present Zoning (no buffer zone)


Societal Risk Intensity
Residential
Institutional
Industry

Restrained Zoning (with buffering)

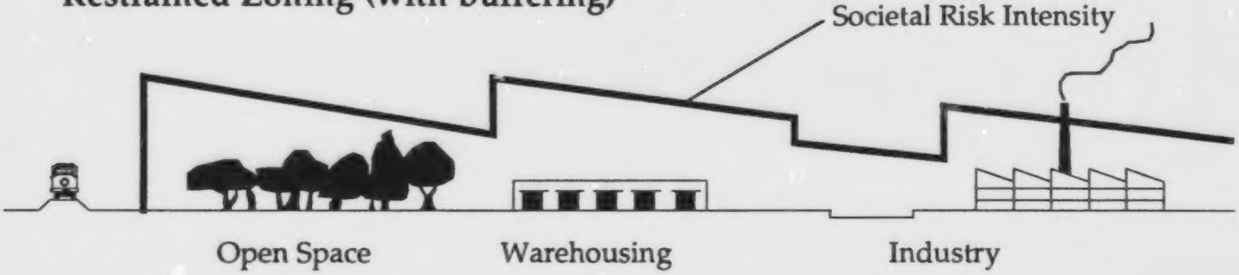

Societal Risk Intensity
Open Space
Warehousing
Industry

Exhibit 3.43
Conceptual Risk
Reduction through
Restrained Zoning

illustrates what is being proposed for Regina, Saskatchewan where they expect to use this same compatibility concept.

3.12.D Buffer Zone Widths

The width of a buffer determines not only the costs involved, but the degree of risk reduction achieved.

The utility corridor established in Edmonton to accommodate a freeway, pipelines and an electric power transmission infrastructure is 2600 ft. wide. The setback corridor proposed in Regina is 2000 ft. wide (1000 ft. on either side of the track.) Our consultants determined that individual risk declines rapidly as the distance from the track increases and that a distance of 400 metres (1200 ft.) on either side of the track would reduce risk to an individual by one hundred fold. This risk would therefore be in the neighbourhood of one in a million chances of being fatally injured - an informal

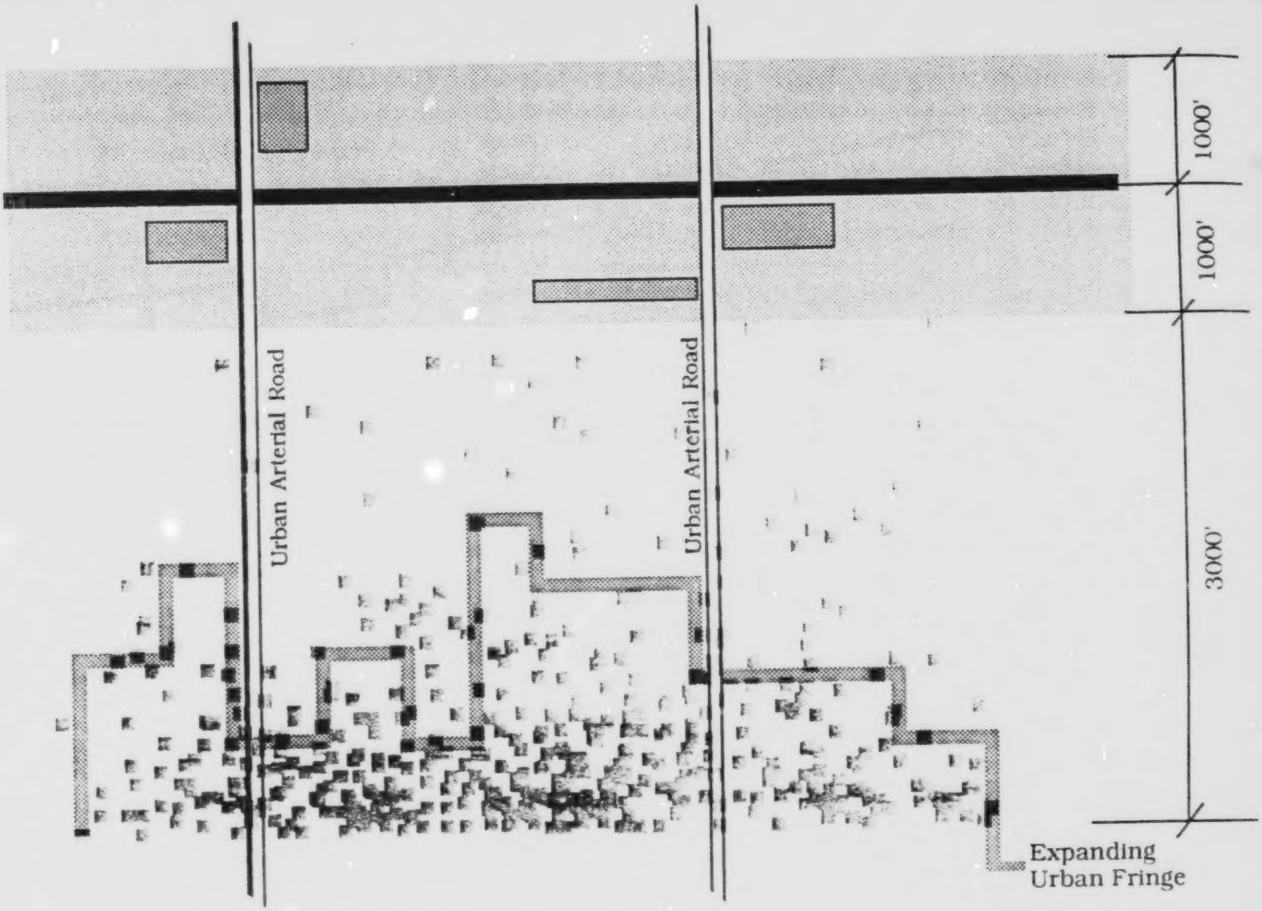

1000'
1000'
3000'
Urban Arterial Road
Urban Arterial Road
Expanding Urban Fringe

Exhibit 3.44
Buffer Zones
Proposed for Regina

☐ Open Space Zone
▨ Population Densities
▒ Expanding Urban Fringe
═ Urban Arterial Road
┼ Rail Corridor
▨ Land use Compatible with Rail Corridor

benchmark used to determine acceptable risk in several European countries. Exhibit 3.45 illustrates this individual risk reduction potential to the public as the distance from the track increases.

People using highways adjacent to a rail line carrying dangerous goods would be subjected to the same individual risk

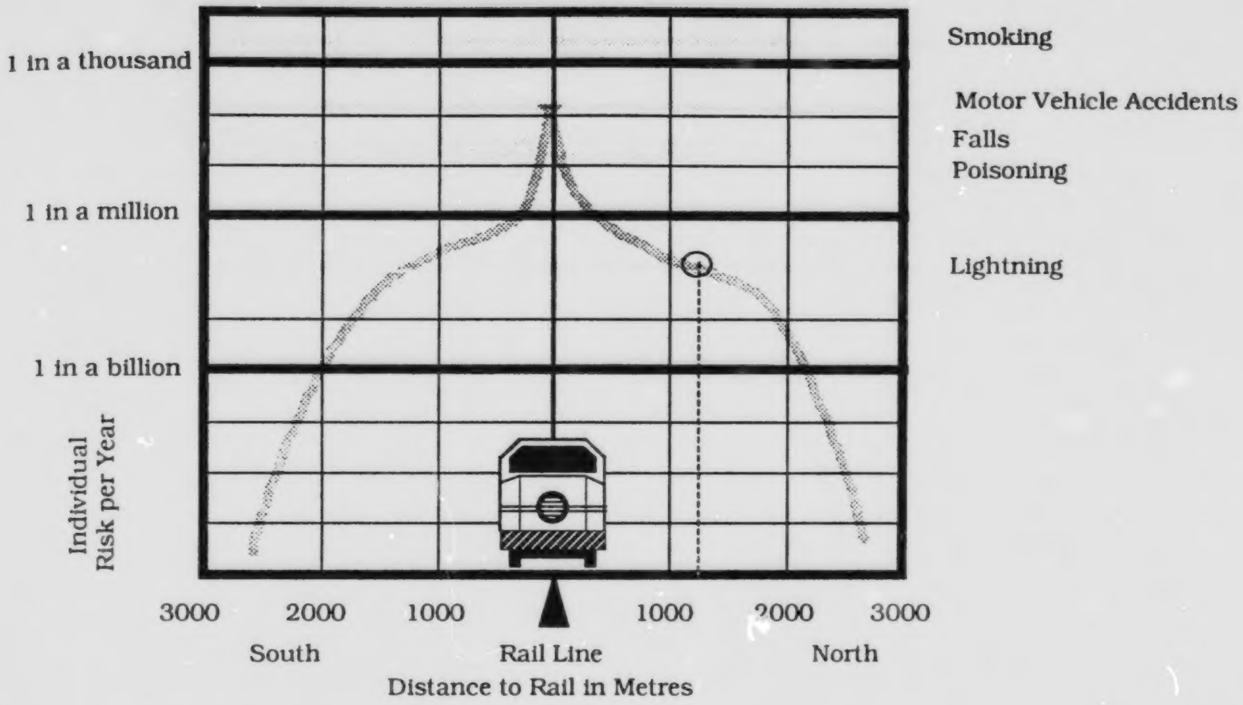


Exhibit 3.45
Individual Risk* Profile for a High Volume Dangerous Goods Rail Transport Segment in the Greater Toronto Area in Relation to other Individual Risks

**This is the risk (likelihood) per year that an individual living at some distance from the rail line would be killed as a result of a Dangerous Goods rail accident.*

Sample Interpretation: If a person lived about 1 km (1000 metres) north of the rail line, the risk of being killed as a result of a Dangerous Goods accident is about the same as the risk of being struck and killed by lightning (i.e. about 1 chance in 8.3 million).

as someone living next to that rail line. However, the exposure time to that risk could be different. In the case of the resident, the risk is experienced intermittently during the passage of dangerous goods trains, but over a protracted period of time. In the case of the highway user, the risk may last a considerably shorter period of time.

In the Parkway Belt alternatives, we have not included road-user risks in the risk figures for the Parkway Belt options. To do so we would have had to calculate the risk at all locations where road transportation routes (urban and rural) are in proximity to rail dangerous goods loads. Then we would have had to accommodate the risk generated by the truck transportation of dangerous goods as well. This detailed road user risk analysis was clearly outside our Terms of Reference.

However, we have concluded that collectively the highway users' risk from the rail transport of dangerous goods would be in the same degree as that of residents living near to rail lines. As such, we believe this risk has been accommodated.

Our consultants advise that buffer zones should be based on societal rather than individual risk. Once the societal risk has been forecast to approach a certain unacceptable level, the determination of buffer distances should then take the risk to individuals into consideration if sterile buffer zones are contemplated.

We are however suggesting compatible-use buffer zones. For these, consideration must be given to limiting risk by such strategies as density reductions. A thorough examination of risk reduction options is needed to determine an acceptable level of risk for communities in the vicinity of rail lines transporting dangerous goods. This we suggest would take the form of an interactive dialogue between the public and their elected representatives.

As the existing system shows, buffer zones cannot be implemented after the fact. It is therefore imperative that serious and comprehensive planning take place before the situation arises.

3.12.E Responsible Level of Government

Such comprehensive planning requires the cooperation of all three levels of Government - Federal, Provincial and Municipal.

We were impressed with the workings of the Aeronautics Act around airports and believe that a similar mechanism can apply to the railways - recognizing that Provincial cooperation must be involved.

Of course, airports differ from rail lines in many ways. An airport is a static site with a limited and defined boundary, and many larger airports in Canada are federally-owned and operated. In contrast, rail lines are a continuous string stretching for many miles, and the rights-of-way are owned by the railway companies. These companies do not have the legislative power to zone outside their rights-of-way, nor do they have the financial ability to acquire sufficient rights-of-way to increase safety to the extent demanded by the public.

It is our opinion that the Federal Government should take the lead role in this area.

We therefore recommend that:

- **The Federal Government assume the responsibility for establishing buffer zone criteria and that this determination should be done with as much input from the Province of Ontario, the Municipalities, industry and the railways as possible;**
- **The Federal, Provincial and Municipal authorities work cooperatively, in their respective spheres, to introduce or make provision for buffers along new rail lines and rail yards in non-developed areas;**
- **Buffer zones be so established as to allow railway- compatible infrastructure and activity, and that such zones be considered for other transportation and utility corridor uses at the same time; and that**
- **As redevelopment occurs along existing rail corridors, the Municipalities ensure that compatible land uses are put into place.**

3.12.F The Greater Toronto Area

The encroachment which has occurred along the existing system is not reversible. The Parkway Belt alternatives to some degree, and the North Corridor especially, offer opportunities to prevent encroachment from occurring further and we urge that these opportunities be seized immediately. Given that the development pressures continue to grow; given the difficulties inherent in the whole land use zoning process; and given our previous recommendations pertaining to the North Corridor option (the 'C' Alternatives). We believe that a priority must be established in this regard.

We therefore urgently recommend that:

- **As a matter of priority, the Federal and Provincial Governments initiate discussions immediately on how, in the Greater Toronto Area, buffers could apply to the Parkway Belt and North Corridor options and from these discussions develop policy that could be applied here and elsewhere.**

3.13 Costs and Who Pays

3.13.A General

The costs of implementing the alternatives, even at the feasibility level of accuracy, are substantial. The costs ranged from $54 million capital dollars for the simplest of the alternatives (A-2), which reduced risks in some areas but increased them in others; to nearly $1.7 billion for the most expensive relocation alternative in the North Corridor (C-2), which produced an overall risk reduction to most of the general public. Increased operating costs were also significant. These incremental cost differences ranged from a savings of $1.6 million annually, to an increase of $36.0 million for the most northerly of the North Corridor options (C-1). These costs are for infrastructure and operations alone, and do not include the cost of acquiring lands for buffering or the costs involved in carrying out appropriate zoning.

While we did not estimate the costs for providing buffers on an actual case by case basis, we did estimate what they might amount to if it were assumed that such costs would only be for zoning to ensure compatible uses; for the settling of injurious damages; and for the acquiring of property, as a last resort, to ensure compatability with rail lines. We estimated the costs based on widths equivalent to those planned for the City of Regina, Sask., and estimated that, in our most northerly option (C-1), the costs would be about $500 million; for the more southerly alternative of the North Corridor (C-3), the costs would be about $300 million.

3.13.B Cost Apportionment

We examined the spectrum of those who would receive benefits from any rerouting and/or relocation of the rail flow of dangerous goods, and who may be expected to bear some of the costs of achieving improved levels of public safety. We concluded that the railways, shippers, the Municipalities, the Provincial Government, the Federal Government (the Regulator of the national rail system), and the general public would all benefit. Each however would benefit to different degrees and each has a different capacity to pay.

The Railways

A higher degree of public safety for the rail transportation of dangerous goods would achieve a higher degree of rail system safety and efficiency in most, if not all, rail operations in the Greater Toronto Area. Higher safety levels benefit the railways through fewer accident costs, reduced in-transit delays and a more reliable system.

We heard, on several occasions, that the railways were responsible for creating the safety problem and should therefore be responsible for its correction. We consider this view to be an oversimplication and offer the following observations:

- The railways have moved some of their infrastructure to non-developed areas only to be encroached upon at a later date, so they are not solely responsible for creating the existing situation. On established lines, they have responded to public demand for the transportation of dangerous goods and have done so responsibly.
- The railways comply with the safety requirements of the Regulator and have achieved a high level of safety compared to other North American railways. They have also employed state of the art techniques, as appropriate, to conditions in the Greater Toronto Area.
- If required to assume all costs required for public purposes, the railways must pass these increased costs to users of the system. If rail costs increase significantly above truck costs, dangerous goods volumes would likely shift to trucks.
- The railways have received little, if any, assistance from the three levels of government to achieve public safety off the rail right-of-way. The Municipalities have paid scant attention to safety zoning for developments adjacent to these rights-of-way, while the Province of Ontario and the Federal Government have not reached an understanding or a common approach to identifying this problem and establishing guidelines for town and city planners. (We wish to note and commend the City of Toronto's recent adoption of an interim land use policy of blocking all development within 50 metres of the North Toronto, McTier and Weston Subdivisions.)

The Municipalities

The most direct beneficiaries of improved rail safety would be the residents of municipalities through which the rail lines pass. However, in the case of the diversion of dangerous goods rail traffic from one part of a municipality to another, or from one municipality to another, the apportionment of benefits or costs appears to be an impractical exercise. As most of the dangerous goods pass through the Greater Toronto Area in the first place, it would seem to us that the municipalities would be justified in saying that they had been bearing a cost in the past which did not belong to them and therefore these benefits would only redress the situation.

The Province of Ontario

While the Province of Ontario does have a mandate for safety (as set out in its own Ontario Planning Act), it has not provided the same guidance to municipalities in the area of rail safety as it has with noise and vibration. It does not have a role in the area of national railway regulation, and to assume such a role may be deemed an infringement on a constitutionally designated Federal responsibility. However, there is a specific role for the Province of Ontario to play as the senior level of government in the Province. This role relates to the planning process as it contributes to the safe transport of goods to, for, and amongst the residents of the Province in general, and of the Greater Toronto Area in particular.

The Province of Ontario, as well as the Federal Government, may also have a responsibility to ensure a safe environment. We sought legal opinion and were advised that the Regulator, whether of land use (the Province of Ontario) or of railway operations (The Federal Government), is responsible for ensuring effective and applicable regulations. While the Regulator can not be held liable for specific actions of those regulated, the Regulator can be held liable if an unsafe situation is known to exist and no actions are taken to reduce the risk. It seems therefore that the Province of Ontario has a role to play. While this role may not be in the actual bearing of costs , it certainly seems to lie in ensuring that the planning processes are in place and that any implementation is not unduly obstructed.

The Federal Government

The constitutional authority for regulating the railways lies with the Federal Government. We believe that its past actions, along with those of the railways, have in fact achieved a relatively safe, state of the art railway system.

Given a relatively safe system (with some segmental, high risk areas), responsibly operated, the question then turns to who should pay when higher levels of public safety are demanded. The precedents all suggest that if society demands a higher than reasonable level of service or public safety, then society pays. We are in agreement with this philosophy.

We therefore recommend that:

- **The Federal Government bear the net cost of any railway rerouting/relocation (after allowing for the benefits that can be achieved with respect to identified railway operating cost reductions; the sale of surplus railway lands; and any identified benefits from rail service rationalization);**
- **The Federal Government be responsible for all costs of buffer zone acquisition and for all injurious costs arising from 'compatible use' zoning; and that**

- **The Provincial Government and Municipalities be responsible for all planning, zoning implementation and administrative activities in this regard.**

3.14 Long Term Conclusions

Rerouting and relocating the rail flow of dangerous goods in the Greater Toronto Area is feasible from an engineering and operational point of view. However, considering the costs involved, any such rerouting or relocation should be justified as part of rail rationalization in the Greater Toronto Area.

On a more general level, we have determined that:

- The risk from the existing system is relatively low compared to other risks encountered on an everyday basis but that an individual rail accident can be of significance (i.e. a low probability, but high consequence type of accident);
- On balance, insufficient justification exists to warrant the rail flow of dangerous goods being relocated for risk reduction reasons alone, but justification may exist where economic benefits along with risk reductions can be achieved through railway rationalization in the Greater Toronto Area and through the use of some of the alternatives we have studied. (As stated previously, one member of the Task Force does not concur with the statement that risk reduction alone does not justify relocation);
- Provision of adequate present and future rail capacity in the Parkway Belt combined with existing trackage would be our preference. (In making this statement, we caution that rail capacity provided must be capable of meeting the total rail volume demands that may be placed on it. Canada's rail system must not be compromised in its ability to meet market demands, present and future, because of rail relocation. The railway representatives on the Task Force feel strongly on this point.); and that
- The more southerly route of the North Corridor options (Alternative C-3) should also be considered as a longer term transportation/utility corridor option for the Greater Toronto Area.

All these conclusions however, have a cost and we have further concluded that:

- Only through a cooperative effort on the part of all levels of government could these costs be met and implementation achieved.

On a more specific level, we have concluded that:

- The density of residential and institutional development which has been allowed adjacent to rail facilities in the Greater Toronto Area has been, in large measure, responsible for the risk arising from dangerous goods accidents;
- Having established rail corridors and facilities, some more than 100 years ago and others as recent as 25 years ago, in lightly populated or undeveloped areas, the railways are unjustly criticized for having solely created the risk to the public. The information system however was not in place which would have enabled these trends to be fully appreciated which, in turn, would have allowed the Federal, Provincial and Municipal Governments to have taken corrective action. At the same time, the railways have not taken cognicance of the public anxieties in this regard and had not moved earlier in a proactive way to implement special precautions regarding dangerous products. (The lack of hot box detectors at the time of the Mississauga derailment — even though research and development into their use was well under way and several pilot installations had been implemented — is an example.);
- Of the present train routes carrying dangerous goods, the greatest safety risks to the public are along Canadian Pacific's North Toronto Subdivision running through the City of Toronto. High risk (but only a third to a half of that on the North Toronto Subdivision) also exists along Canadian National's York Subdivision running parallel to Steeles Avenue in the southern part of the Regional Municipality of York; and that
- Public safety is a prominent and growing concern with citizens and all levels of government in the Greater Toronto Area. This concern, and relevant mitigating measures, should be addressed through the undertaking of risk assessments on all major initiatives of the railways, especially when these may affect present and future public safety.

Finally, we emphasize that a long lead time is required to achieve the benefits offered by rerouting and/or relocating the rail flow of dangerous goods in the Greater Toronto Area. This course of action can only be viewed as a longer term solution.

4.0 Improving the Existing System

A Shorter Term Option

4.1 Introduction

From the beginning, our principle objective was to improve rail safety. If the question were now asked "Is the existing system reasonably safe?", we would reply in the affirmative. And if the question were asked "Can the system be made safer?", the answer would also be in the affirmative.

We have emphasized that the public wants to be assured the rail system is safe and that "all that can be done, is being done". While rerouting the rail services is one of those things that 'can be done', several other avenues provide shorter term opportunities to improve safety.

Some of these opportunities, related to the role of the Regulator and legislative mechanisms, were outlined in Chapter 2.0. In this chapter we look at the operational, managerial and technological aspects of the existing system, speed regulations, the human element of the system, and emergency response capabilities.

To learn as much as we could in this area, we commissioned consultants to investigate emergency response and environmental issues, and the latest technological advances in rail transportation. We initiated a special study on the issue of speed. We listened to experts on such topics as the brittleness of steel in frigid temperatures, and the field of drug or alcohol abuse.

We visited Transport Canada's Transport Development Centre and Canadian National's Research and Test Laboratory in Montreal; the National Research Council's Fire Test and Transportation Laboratories in Ottawa; Canadian National's Training Centre in Gimli, Manitoba; Canadian Pacific's Advanced Train Control System field test in Calgary; the Research and Special Projects Administration's Transportation Systems Centre in Cambridge, Massachusetts; and the Association of American Railroads' Research and Test Centre in Chicago and its Transportation Test Centre in Pueblo, Colorado. Our Chairman also visited the British Rail

Research Centre in Derby, U.K. During these visits, we learned of ongoing university research projects in Canada, and in the USA, and of the work of industry-oriented research agencies, such as the Railway Progress Institute.

We are grateful to all of those who gave so freely of their time and thoughts. Their contributions were of great assistance to us.

4.2 Comparison of Canadian Railways to Other North American and European Rail Systems

We compared the operation and safety record of the Canadian National Railways and the Canadian Pacific Railway with that of several European and American systems. During 1981-85, both have been among the top five safest North American railways, in terms of train accidents per million train-miles. During 1983-85, Canadian Pacific ranked first. This data is shown in Exhibits 4.1 and 4.2.

A comparison of Canadian Pacific with the national railways of nine European countries is given in Exhibit 4.3. It is extremely difficult to compare rail safety statistics with those of railways outside North America. But it is worth noting that, while Canadian Pacific has a higher accident rate per million train-kilometres than any of the nine European railways, in terms of the accident rate per million gross tonne-kilometres, its performance is vastly superior to that of any European railway with the exception of France.

However, the comparison between Canadian Pacific and the European railways really tells far more about the differences in the railway systems in North America and Europe than it reveals about railway safety. To move goods economically through Canada's large geographic expanse, both Canadian railways pull longer and heavier trains than those in Europe. In addition, European rail systems have a higher percentage of passenger trains.

Given these qualifications, it is notable that the results all fall in the same range. There is a much greater spread between the best and worst in North America than there is between European and North American averages. This leads us to the

Exhibit 4.1
Train accidents Per
Million Train Miles

Canadian and US Railways, With Data added
for UK Railways.
Canadian and US data normalized to US reporting criteria.

Railway	1981	1982	1983	1984	Jan/Sept 1985
CP Rail	4.68	5.30	3.14	2.76	1.95
Southern	4.80	4.42	3.99	3.45	2.52
Atchison, Topeka & Santa Fe	4.30	4.07	4.08	3.64	3.92
Union Pacific	4.60	5.30	4.60	5.09	4.16
CN Rail	5.40	5.78	5.32	4.67	4.24
Seaboard System	7.63	6.10	4.49	4.37	4.30
Burlington Northern	9.00	8.42	6.98	6.09	5.42
Illinois Central Gulf	8.10	7.21	5.83	5.33	5.30
Conrail	9.50	8.38	6.16	6.56	4.12
Chessie	8.30	10.06	6.05	7.73	7.26
Missouri Pacific	7.70	7.13	7.31	6.99	10.67
Norfolk & Western	6.90	8.08	7.19	6.70	7.34
Southern Pacific	14.50	13.15	14.52	13.99	12.50
Chicago & Northwestern	20.40	21.13	19.61	13.23	12.68
Chicago, Milwaukee, St. Paul	20.60	26.26	23.41	26.61	22.96
Average US Class 1 Roads	8.30	7.77	6.96	6.47	5.78
UK Railways	3.47	3.79	4.50	4.92	4.21

hypothesis that railways on both Continents are using mature technologies, and getting broadly similar results.

And it confirms that no technology employed on either Continent could, on its own, dramatically effect the safety performance of railway operations in Greater Toronto. Good safety performance is obtained by a total systems approach: the correct application of appropriate technologies, together with the proper training, motivation, and discipline of system personnel.

Our consultants drew three principle conclusions from their review of technology.

i) With very few exceptions, rail technologies in the Greater Toronto Area are equal to the state of the art for similar operations elsewhere. The engineering and operating standards used on Canadian Pacific's North Toronto Subdivision and Canadian National's York and Kingston Subdivisions a

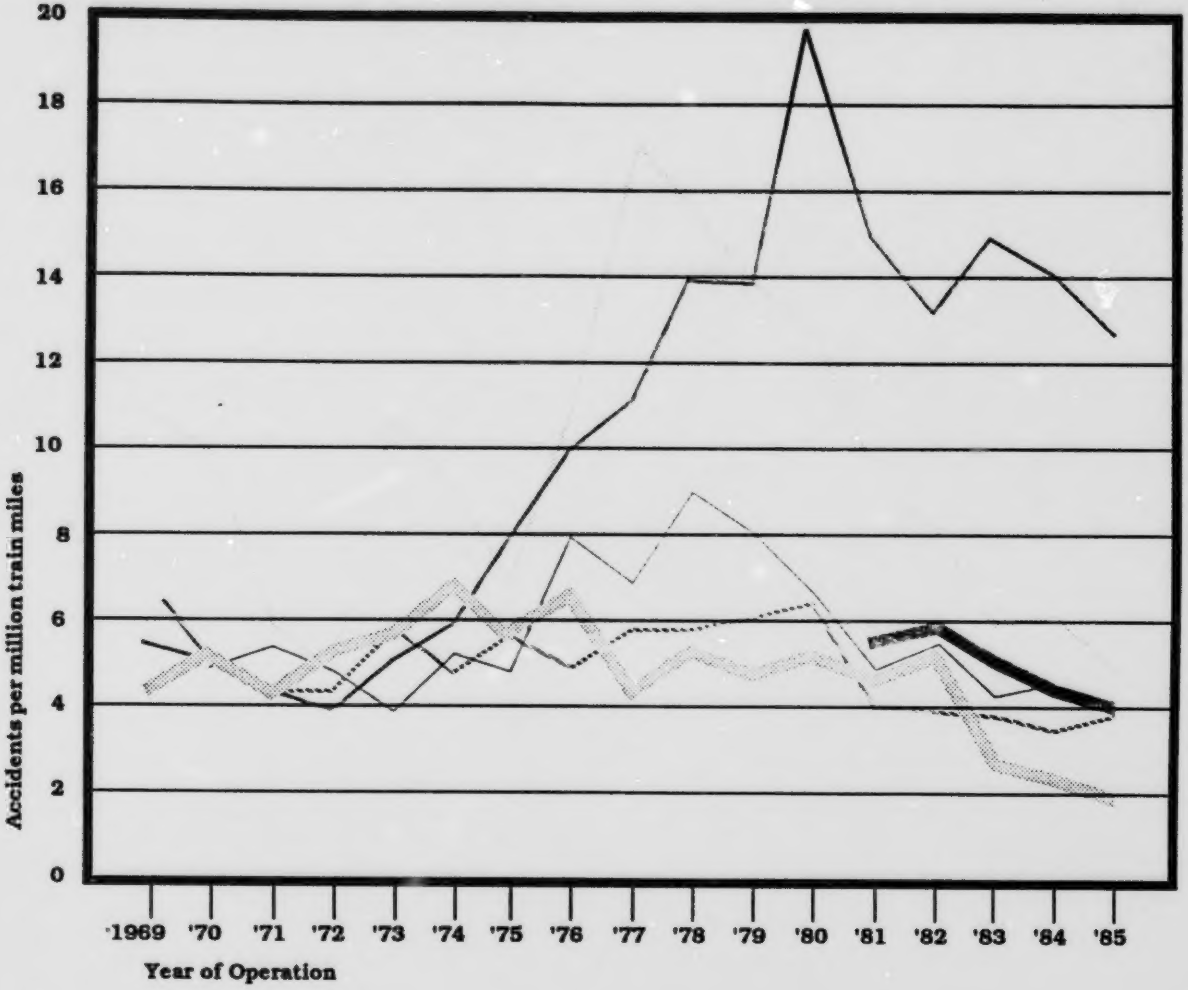


Exhibit 4.2
Mainline Accident Record of North American Railways

Exhibit 4.3 European Railway Accident Record - Average Annual Data 1981-83

				Accidents rates per	
	Derailments	Collisions	Total Accidents	million Train-kms	billion Gross t.-km
Austria	37	100	137	1.34	3.53
Belgium	174	79	253	2.64	7.07
France	62	325	387	0.77	1.05
Great Britain	157	403	560	1.34	3.89
Netherlands	78	123	201	1.78	7.76
Norway	19	28	47	1.33	n/a
Sweden	74	127	201	1.96	4.56
Switzerland	14	84	98	0.97	2.75
West Germany	264	828	1,092	1.86	4.36
CP Rail	103	111	214	5.22	1.26

are state of the art worldwide for freight operations up to 60 mph.

ii) There are technologies which could be used within the Greater Toronto Area which can contribute to a reduction of the risk of an incident involving dangerous goods. At present, these technologies are used where there are intensive or high speed passenger operations. The proposed Advanced Train Control System project is one such system. (We will discuss these systems in more detail).

iii) The interface between technological and human systems is of particular concern in both Europe and North America. To continue reducing the risks of rail operation, attention must be focused on the standards of performance possible from the' human element' of the railroad transportation system. (We will discuss this in the section entitled 'Human Factor Improvements'.)

4.3 Operational Management Improvements

4.3.A General

In this section we discuss how the existing system is managed, monitored and modified.

Railway researchers told us that research projects generally stem from the need to correct a specific problem, or from a desire to improve productivity. Operators and crews told us about track design speed and conditions, and how train speed or tonnage are reduced when track conditions deteriorate. We also learned about inspection procedures and the use of ultra modern train dynamic and track analyzer inspection cars.

What we did not find however, was a sense of 'system'; an ordered approach within railway operations, which would assure the general public that the rail operation is being maintained at the highest of standards, and that public safety is held as a top priority. We are not saying that rail operations in Greater Toronto are unsafe or that personnel do not have safety as their top priority. We are saying that it is extremely difficult for any person, other than someone from the railways themselves, to assess the degree of safety in rail lines running through highly urbanized areas.

The Task Force therefore wishes to make the following suggestions for improvement.

4.3.B System Safety Analysis

In railway operations there are two basic elements — technology and human — which contribute to safety.

Human systems are those which are manually carried out through observance of rules and procedures, such as the activities of train crews and train dispatchers. These systems are usually always active.

Technological systems may be either active or passive. They are active if they react to unsafe conditions and issue a warning (eg., hot box detectors). In some cases active systems also assume control when unsafe conditions occur, such as when speed and access authorities are exceeded.

Passive technological systems are those such as track and signaling equipment which perform predictably and reliably, if properly maintained, but do not give warning of impending failure. Impending failure must be detected through inspection. Within the passive side of railway operations, components are replaced and repaired as fatigue limits are approached, as actual deficiencies occur, or as impending failures are detected. (It should be noted that while the above systems are not capable of giving a warning of impending failure, they are designed to maintain the 'fail safe' philosophy of the railways. This means that component failure or a break in track continuity would cause signals to display 'Stop'.)

We believe that just fixing a deficiency — tackling one problem in isolation from the total system — does not go far enough. Any such changes should undergo a complete System Safety Analysis.

System Safety Analysis is a recognized professional technique based upon a disciplined analytical approach to safety. It distinguishes safety from reliability. The approach uses objective data for each element in the system, and through such techniques as fault and consequence analysis estimates failure probabilities. The failure probabilities for each element determines the failure probability for each system component which, in turn, determines the safety of operating units as a whole. Working in reverse, an accepted failure probability for the operating system as a whole will establish safety requirements for each element in the system.

This System Safety Analysis approach is common to the rapid transit industry. In this industry, safety objectives are first established and then a thorough analysis of all the component parts of the system is undertaken to ensure that these safety objectives are achieved. This approach to safety has significant merit and should be employed in densely populated locations, such as the Greater Toronto Area, where dangerous goods are transported. Safety objectives would be established between the railways and the Regulator.

The methodology is employed by British Rail, and we employed fault and consequence analysis as part of our own risk assessment methodology. A preliminary base of data therefore exists for the Greater Toronto Area.

We recommend therefore that:

- **System Safety Analysis be assessed by the railways and the Regulator as an approach to improving public safety and that the Greater Toronto Area be considered for a pilot application of this System Safety Analysis technique; and that**
- **The preliminary failure probability and consequence data base established by the Task Force for the Greater Toronto Area be considered as a starting point for System Safety Analysis.**

4.3.C Level of Safety Classification System

In our investigations, we learned of the enormous amount of engineering and design work that has gone into the building of today's railways. We were impressed with the details incorporated in track standards, and the need to accommodate such different operations as fast moving passenger trains and slower moving, heavy freight operations.

We were, however, concerned that there is no formalized classification system against which the railway operations can be monitored effectively and independently. Such a system is used for Ontario's highway network to establish different levels of service, capacity and maintenance standards. The system guides policy decisions about which 'level' would be applicable, as well as the activity of any monitoring agency or individual. A similar system is in place for managing Canada's airport and aviation system.

Such a system for the railways, especially where dangerous goods are involved, would substantially improve public confidence in the railways, providing a structure and guideline objectives against which railway maintenance and inspection efforts can be judged.

The system would allow the railways, in conjunction with the Regulator, to classify all segments of their system as they see fit. Once this is done, the public would have a way of measuring safety and performance. Of course, provisions must be made to allow rail segments to be reclassified when conditions warrant. These changes, however, should be made known to the public so that their monitoring can continue in an effective and knowledgeable manner.

We recommend therefore that:

- **The railways, in conjunction with the Regulator, implement a classification system consistent with statutory speed restrictions and containing a number of levels, applying to all aspects of their fixed plant and train operations; and that**
- **This classification system be made available as public information against which monitoring can be undertaken.**

4.3.D Dangerous Goods Classification Level

Rail lines carrying special dangerous goods through densely populated urban areas should be specially designed and maintained, to provide an additional margin of safety over and above that for which they would normally be classified. These lines should be labelled as 'DG' lines.

These DG levels of rail infrastructure and operation would incorporate enhanced margins of safety in track design and construction; more restrictive tolerances in allowable variation from track classification; geometric design parameters; intensified track inspection by visibly recognizable personnel; increased inspection passes by automated analyzer cars; and more frequent placement of wayside detecting equipment. All this should be accompanied by enhanced communications with the Municipalities and general public involved. In addition, crews operating in densely populated urban areas should be fully aware of their responsibilities to the communities through which they pass and this heightened awareness should be part of the DG Classification criteria.

Any operation handling dangerous goods deserves special attention to safety, in excess of that required for other freight traffic. The consequences of accidents can be considerably different in each case. While we acknowledge the statements made by the railways regarding the adequacy of their present plant and operations, and the supporting comments of our consultants, we feel that the high level of public concern requires that something more must be provided.

We recommend therefore that:

- **Special Dangerous Goods (DG) levels of classification be established for rail infrastructure and operations carried out in densely populated urban areas where the transportation of special dangerous goods is involved; and that**
- **These Dangerous Goods Classification levels be assigned the highest standards of design, construction, inspection, maintenance and operation.**

4.3.E Track Quality, Inspection and Wayside Improvement

We would like to discuss technology improvements and DG classifications in three specific areas: track quality, track inspection, and wayside detectors.

Track Quality

Track in Canada is designed, maintained and classified by each railway company for a certain level of service. This is carried out in accordance with recognized engineering principles, backed by many years' experience in building and maintaining track. The basic design is reviewed by the Regulator before being approved for use by the company. The track is also inspected by the Regulator before being put into service, and periodically thereafter.

The track in the Greater Toronto Area is built and maintained to a standard required for basic operation, but this standard is not specifically related to the handling of dangerous goods. While this quality does ensure a reasonable degree of safe performance of all operations, including those involving dangerous goods, we feel that something more must be provided that can be clearly identified by the public.

Since track integrity depends to a large extent on the ability of the ties and fasteners to hold track in place, further discussion on this matter can be found in section 4.4.B — Technology Improvements; Concrete Ties and Direct Fixation Fasteners.

Track Inspection

In the effort to ensure an extra margin of safety in design and construction, we believe that track carrying dangerous goods should also be subject to intense inspection.

Detailed inspection and maintenance procedures are regularly carried out by the railways. The inspectors and maintenance crews should however be more visibly identified, should be fully experienced, and should have special training to ensure competence. Written proof of such training received, and refresher courses taken, should be available for inspection. Senior maintenance personnel should make quality control inspections of the system and procedures as well.

Track inspection in high risk areas should be carried out more frequently than regulations now require. This increased inspection frequency would form part of the DG levels for track classification.

Both railways own and operate electronic track-test cars to monitor and record track geometry and rail condition. It is our view that increased use of this equipment, in high risk areas that handle dangerous goods traffic, should be carried out by both railways. This increased inspection frequency and reduced tolerance variations would also form part of the DG levels for track classification.

We recommend therefore that:

- **A significantly increased and more intense inspection effort be undertaken by the railways in the densely populated urban areas of the Greater Toronto Area; and that**
- **These increased levels of inspection be incorporated as part of the designated Dangerous Goods (DG) Classification levels assigned to this Area.**

Wayside Detectors

Automatic detectors (or inspection points if detectors are not installed) are now in place to detect hot wheel bearings, hot wheels and dragging equipment. These detectors are located on all major rail routes entering the Toronto Census Metropolitan Area (CMA).

Any train carrying dangerous goods entering the Toronto CMA must receive a 'gateway' inspection at the boundary, either by an electronic detector or by a manual inspection of the standing train. A further inspection, either electronic or manual, must be repeated every 20 miles within the Toronto CMA, until the train reaches its destination or leaves the area. If no inspection is made, train speed must be reduced.

Freight car roller bearings reach a distressed condition far less frequently than do plain, or friction, bearings. However, when a roller bearing begins to break down, it can fail more quickly than a plain bearing. As a result, these roller bearings may fail within the present 20 mile spacing of detectors, without incipient failure being detected beforehand.

We recognize that protection against derailments due to bearing failure has been greatly enhanced by gateway and intermediate inspections, and by statutory speed reductions for dangerous goods trains travelling in densely populated urban areas. Yet we feel a positive contribution can be made to rail safety, and particularly to public confidence, if the spacing of electronic detectors within Toronto's CMA were to be further reduced.

We recommend therefore that:

- **Properly maintained wayside detectors be spaced more frequently than present regulations demand within densely populated urban areas of the Greater Toronto Area; and that**
- **This reduced spacing be incorporated into the Dangerous Goods (DG) track Classification level established for such areas.**

4.4 Technology Improvements

4.4.A General

Even though technologies and standards in the Greater Toronto Area are 'state-of-the-art', opportunities do exist for improvement. We have reviewed possible improvements to identify those that are practical in the Canadian context.

4.4.B Application of Practical Technologies and Infrastructure Improvements

We wanted to identify technologies which could provide specific benefits quickly, and which had a proven record of achievement. Our consultants reviewed and examined a wide range of technologies presently being employed in North America and elsewhere, as well as technologies in the research and development stages. They also examined various operating practices and infrastructure technologies employed in other countries. They identified four major areas relevant to the Greater Toronto Area:

- Advanced Train Control Systems (ATCS);
- Concrete ties and direct fixation fasteners;
- Automatic half-barriers at rail/road crossing locations now only protected by flashing lights and cross-buck signs; and
- Grade separation between tracks and the roadway system, where justified by traffic volumes.

Advanced Train Control System (ATCS)

The Advanced Train Control System (ATCS) technology employs sophisticated telecommunications and computer systems and hardware to close the information and operational loops of the railway system. It enables the information from the wayside signals to be brought into the locomotive cab, and can control the train, within prescribed parameters, if the engineer fails to do so.

Such a system has been used in Sweden since the later 1970s, and one is being developed in North America as a joint railway industry effort. Canadian Pacific and Canadian National are leaders in this effort. We operated ATCS simulators in Gimli, Manitoba (Canadian National's Training Institute) and rode a rail locomotive prototype in Calgary, Alberta, at Canadian Pacific's field testing facility which was totally controlled by the equipment and not by the engineer. We were very impressed with the efforts and dedication applied to this project.

This system is being developed in several modules,at different levels of sophistication to suit operational needs. This allows a phased-in approach to the modernization of the railway system.

We recognize the decision of the Minister of Transport, following Justice Foisy's Inquiry into the Hinton, Alberta collision, regarding the urgency for the implementation of the ATCS. We commend and fully support that decision.

We analyzed the ATCS in terms of the potential risk reduction to the general public. At the 'Level 20' degree of sophistication, the system is estimated to reduce collision frequencies by up to 50%. The ATCS 'Level 30' could reduce accidents caused by speeds exceeding track design conditions by about 75%. Collisions and derailments caused by failing to comply with fixed signals could be reduced by up to 50%.

While train collisions and derailments are already small in number, we believe these gains are significant and could yield economic benefits to the Railways.

Recognizing that ATCS track transponders and signaling systems are 'geography-specific', we are convinced that sufficient justification exists to give priority to densely populated urban areas, such as the Greater Toronto Area, in the installation of ATCS facilities.

We recommend therefore that:

- **Advanced Train Control System implementation be given top priority and the full support by all concerned; and that**
- **The Greater Toronto Area be selected as one of the first locations for Advanced Train Control System implementation when such technology has been proven.**

Concrete Ties and Direct Fixation Fasteners

Our consultants suggest the use of concrete ties with direct fixation as an achievable, visible and technologically sound measure. Currently, hardwood ties with cut-spike fixation are used in Greater Toronto. Concrete ties provide a wider, heavier base, and direct fixation resists gauge widening. Along with the use of continuous welded rail, they provide improved track stability over and above that of the present tie standards.

The railways did indicate to us that direct fixation can be provided on existing hardwood ties with screwed spikes. However, it is our view that the wood tie is still subject to deterioration and the improved stability of a heavier tie and wider base is not achieved. The quality, durability and longevity of the end result may compare to, but does not equal, a concrete tie installation. (One member of the Task Force believes that hardwood ties with direct fixation would provide sufficient safety benefits while avoiding the noise and vibration associated with concrete ties.)

The full replacement cycle of the present hardwood ties is approximately 20 years. If concrete ties are installed, they must be used consistently and uniformly. We believe that justification exists for an accelerated program of installations in the densely populated urban areas of the Greater Toronto Area.

We therefore recommend that:

- **An accelerated program of concrete ties and direct fixation fasteners be undertaken in conjunction with a continuous welded rail program in the densely populated urban areas of the Greater Toronto Area.**

Even though concrete ties are more rigid and tend to accentuate the noise and vibration of rail lines, they do contribute to a safer rail system. Our consultants estimated that accident frequencies due to gauge defects could be reduced by up to 65%; track alignment defects by up to 50%; and superelevation and cross-level defects by up to 12% each. Public safety does therefore benefit from this technology.

We further recommend that:

- **As a public safety priority, concrete ties and continuous welded rail be installed in the segmentally-identified, high risk areas of the Greater Toronto Area first, followed by the other locations in this Area. (It should be noted that two members of the Task Force feel that "other locations in the area" must first meet a high risk criterion to be eligible for such corrective action.);**
- **This concrete tie program be the subject of a railway/community discussion since increased noise and vibration may result; and that**
- **This implementation be subject to an agreed schedule with The Regulator.**

Installation of Automatic Half Barriers

Fatalities at grade crossings account for approximately 60% of all fatalities involving trains and while, in most of these cases, trains are not derailed, there exists the potential that such an accident could cause a dangerous goods derailment.

Installing automatic half barriers at locations currently protected only by flashing lights and signs could reduce the frequency of derailments arising from grade crossing collisions by 10%. This accident frequency would be reduced to zero with full grade separations.

Automatic half barriers and signals are presently activated by sensors at fixed distances from the crossing, regardless of the train's speed. When a barrier or signal is activated by a slow moving train, motorists often become impatient and take unnecessary risks by driving ahead. Of course, faster moving trains cover the same distance much more quickly - occasionally catching errant drivers by surprise. Our consultants advise that integrating speed sensors with grade crossing signals would alleviate the problem caused by different train speeds.

Grade Separations

Grade separation would eliminate this interface problem completely. However, road/rail traffic volumes must be sufficient to warrant the expense this involves.

We nevertheless believe that in densely populated urban areas a strategy for grade separations should be given more serious consideration, because of the wide geographic area affected by a dangerous goods spill. Public safety should be given priority consideration over impersonal traffic volume criteria when it comes to making grade separation decisions.

As will be discussed later, an important element to reducing train accidents lies in the ability to keep in-train forces to a minimum. Grade separations, especially in densely populated urban areas, reduce the need to change speeds.

Our rerouting and relocation costs, reported earlier, have incorporated the cost of grade separations at all likely crossings. We note, however, that in recent years the Federal Government has greatly reduced funding available for grade separations.

We recommend therefore that:

- **All attempts be made to reduce accidents at road/rail grade crossings, where only flashing lights and signage now exist, on lines carrying dangerous goods, through an accelerated program of automatic half barriers, with train speed sensor activators;**
- **All attempts be made to reduce accidents at road/rail grade crossings, on lines carrying dangerous goods,**

through an accelerated program of grade separations, where sufficient train/motor vehicle volumes warrant such action and where public safety is of concern;

- **Public Safety be used as an added criteria in determining the need for grade separations along rail lines carrying dangerous goods in densely populated urban areas; and that**
- **The Federal Government re-instate funding for a meaningful grade separation program.**

Accumulated Cost and Risk Reduction Effect of Technology Improvements

As mentioned, the present railway system in Greater Toronto is already in many ways 'state-of-the-art'. No technology will, in itself, reduce risk dramatically in the existing system.

But there can be incremental improvements. The aggregate, societal, system-wide risk reductions achieved by these technological improvements would lower the 'estimated fatalities' from 4.1 to 3.8 for the year 1991.

Exhibits 4.4 and 4.5 illustrate the risk/cost relationship of technological improvements and compares it to the rerouting and relocation options previously studied.

The Task Force strongly believes that all improvements, whether they be technological as described here or those considered elsewhere in this Report, must be advanced to enhance public safety where the rail flow of dangerous goods impacts on densely populated urban areas.

4.5 Tank Car Technology and Train Operation Improvements

4.5.A General

We heard many suggestions that, instead of moving the rail lines, we should investigate the possibility of an 'indestructible' container, ways to ensure that higher maintenance standards were applied, or ways to prevent accidents from happening in the first place. These suggestions came from Mayor John West of Aurora, the Regional Municipality of York, and the Institute of Urban Development (Ontario), to name but a few.

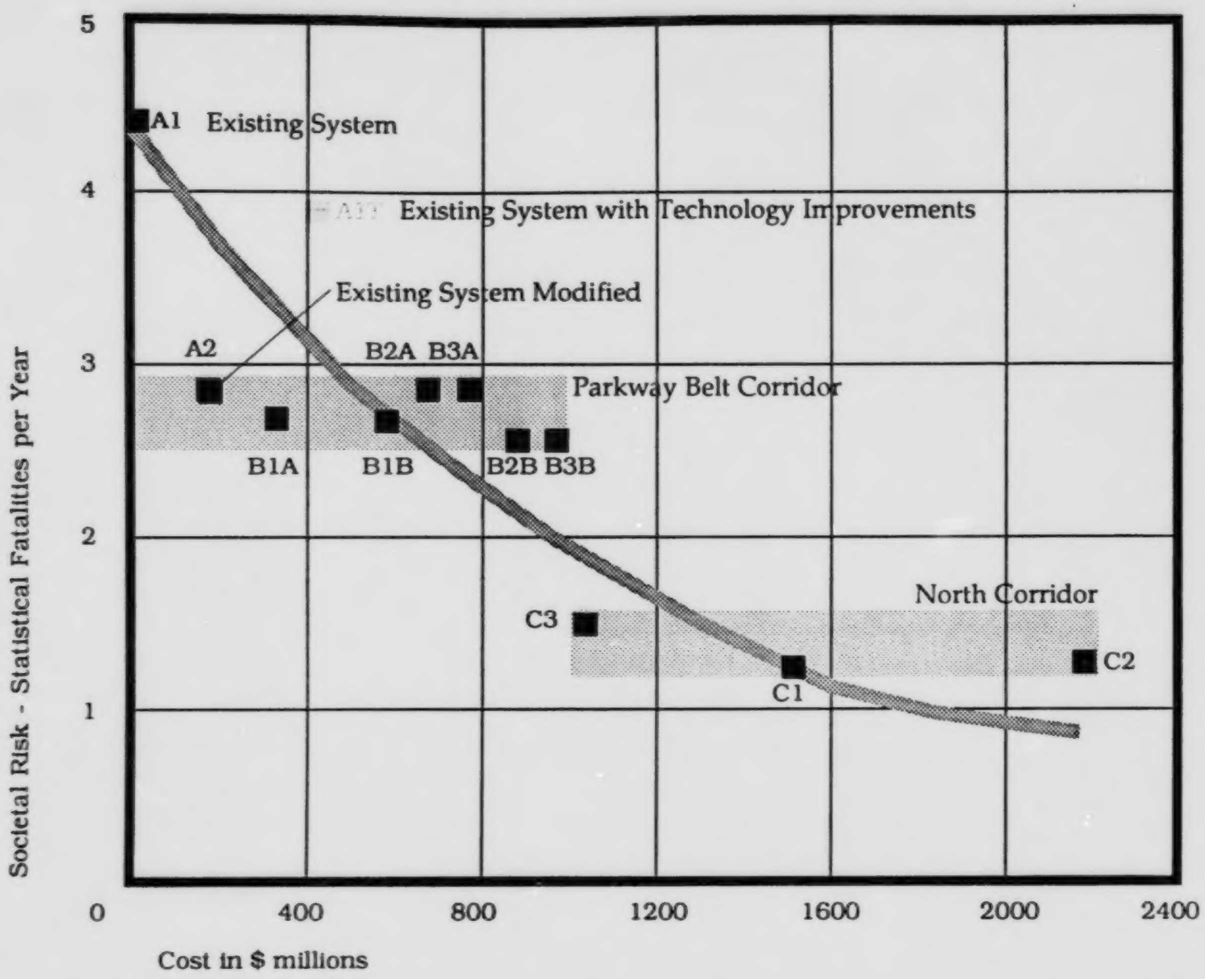


Exhibit 4.4 Risk vs Cost Highlighting Technological Improvement in Comparison with Other Alternatives

▨ Risk Similarities

▬ General Risk Cost Curve (risk values have been averaged between 1991 through 2011)

Because of our own concerns in this area, we consulted experts such as Dr. G. Whetherly, a person with a world wide reputation in metallurgy. We visited Procor Limited, a Canadian manufacturer of rail tank cars in Oakville, Ontario. And we visited the test laboratories of the Association of American Railroads in Pueblo, Colorado. We also asked our consultants to investigate improvements in tank car technology.

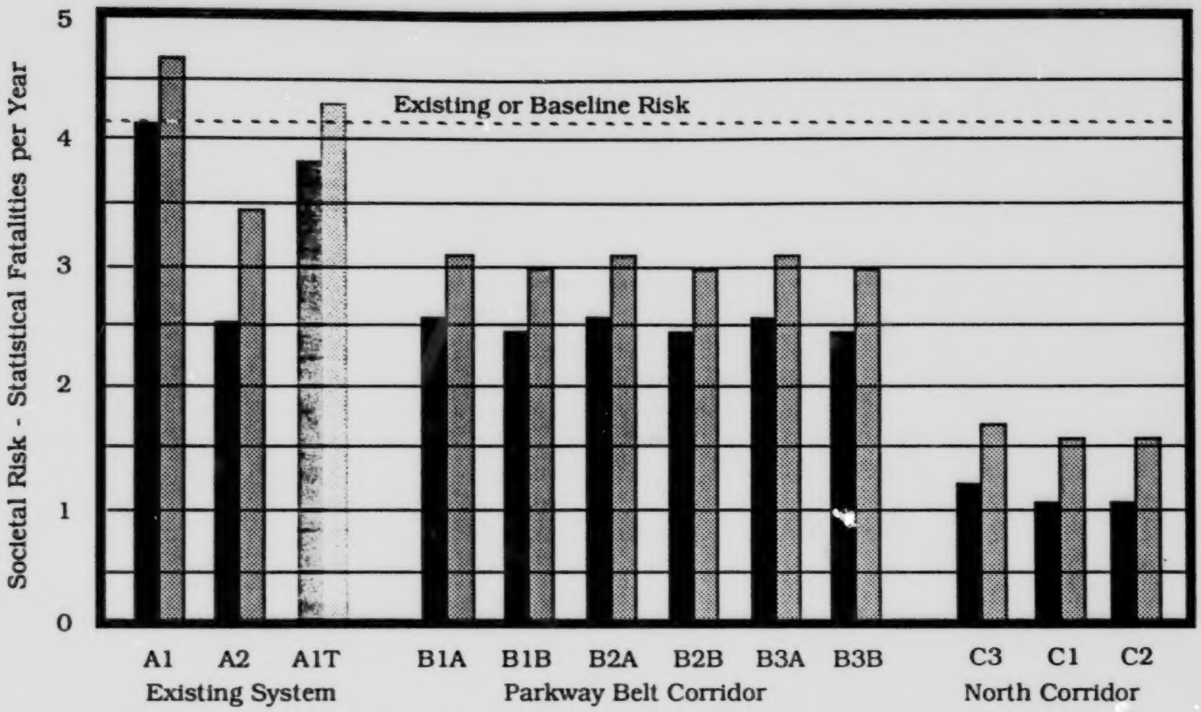


Exhibit 4.5

Comparison of Societal Risks for Rail System Highlighting Technological Improvements in Comparison with other Alternatives

4.5.B Tank Car Technology Improvements

Most special dangerous commodities are transported in tank cars. We felt it was necessary to learn all we could about how they are designed, fabricated, maintained, repaired and improved. We also wanted to know whether a so-called 'indestructible container' — a tank car that could withstand an accident — was a realistic possibility.

(As a point of information, when we refer to the Tank Car, we are referring to all of its parts - the tank and its fittings.)

Tank Car Design

Tank cars are built for specific commodities by request from a potential shipper. Tank car design and specifications must be approved by the Tank Car Committee of the Association of American Railroads. If an existing tank car design is not suitable for the intended application, approval for a new or modified design must be obtained.

The approval procedure for tank cars is presented in the Association of American Railroads' "Specifications for Tank Cars". Car builders are required to submit comprehensive engineering documentation verifying that a proposed tank car complies with all requirements, including structural strength and commodity pressure retention, as set out in the Specifications.

Each new design must be tested in conformance with the Association's rules for demonstrating structural integrity. It must also be tested to show pressure-tightness of shell and fittings to the design specifications. It is the responsibility of the car builder to verify that each new tank car conforms with the appropriate specifications. Many shippers have their own inspectors and visit the car builder's facility during construction of their leased, or purchased, tank cars. The Association also retains the right to inspect a certified tank car facility at any time.

The regulatory authorities (the Canadian Transport Commission and the United States Department of Transport) do not issue detailed design specifications for tank cars, other than the calculation that is required to determine the minimum shell plate thickness of the tank. These Agencies, however, are responsible for designating tank car specifications, used to transport a specific commodity. Thus each regulatory Agency publishes a comprehensive list of commodities by chemical or technical name, and the designated tank car specifications considered suitable for the transportation of each commodity.

In addition to the above, both regulatory Agencies have issued additional regulations applicable to tank cars, which state the performance requirements of other aspects such as thermal protection, tank head puncture resistance and the use of double shelf couplers.

When the regulatory Agencies specify design changes, these must be incorporated into the Association of American Railroads' standards. Thus every component that constitutes a completed tank car has a corresponding Association of American Railroads' design specification established by a committee of engineering specialists with extensive expertise in that area. This expertise draws upon an experimental data-base comprised of nearly two million freight cars within the Association of American Railroads' system both here in Canada and in the United States.

The fundamental criteria for determining an applicable tank car specification lies in the vapour pressure value at 105°F for non-insulated pressure cars. However, because of additional hazard factors, a commodity may be required to be transported in a car of a greater pressure class, thus requiring a thicker shell than justified by pressure retainment alone. For example, the vapour pressure of chlorine at 105°F would indicate that a 105A300W specification should be more than adequate to transport this product safely. It was decided however, that a 105A500W specification would afford an additional measure of protection, with the result that the standard 55 ton, 85 ton, 90 ton chlorine cars have a shell thickness about 1/8 inch thicker than the mininum level. Chlorine is generally shipped at a pressure of about 35 p.s.i.g., with the minimum safety valve pressure setting of the tank calibrated at 225 p.s.i.g.. The tank car itself is hydrostatically tested at 500 p.s.i.g.. Thus, in the case of chlorine tank cars, a significant reserve of pressure retaining strength is always available. In a similar way, motor fuel anti-knock compound, which is a liquid at ambient conditions, is required to be shipped in a 105A300W specification car with insulation and a thick metal jacket; bromine requires a 105A300W specification tank car with a nickel-clad steel tank lined with 3 lbs. per square inch of lead. Each regulated commodity is therefore reviewed for special risks and additional specification requirements are developed to compensate in each case.

We are impressed with the process and the expertise that goes into tank car specification and design. While we have recommended that the Regulator play a stronger, and more proactive role in enhancing the safety component inherent in these Specifications, and that Canada and the United States formalize the process by which the international, cross-border standards can be promoted and enhanced, we wish to commend the work done to date by the Association of American Railroads' Tank Car Committee. They have contributed significantly to the cause of enhanced public safety in the rail flow of dangerous goods, especially in densely populated urban areas.

Tank Car Fabrication

The Association of American Railroads' Specification Manual for tank cars also contains extensive requirements for the fabrication of tanks and the assembly of appurtenances. The fusion welding on car tanks themselves, including plate preparation prior to welding; the welding process; and the subsequent testing (including radiographic examination of the main welds) is also included in this Manual. Each tank car fabrication facility is required to perform qualification tests for its welders and the procedures they must follow. Each plant must have a quality control program specifying the inspection responsibilities of the fabricator, and how inspections are to be documented.

Each tank car manufacturing facility is required to be certified by the Association of American Railroads for fabrication, assembly, alteration, conversion, repair and testing of tanks. This is carried out in accordance with a prescribed set of equipment, skills and organizational expertise. The Association of American Railroads produces a list of certified plants showing their approved capabilities. Such plants must be recertified at intervals of five years. The Association of American Railroads' Tank Car Committee reserves the right to inspect certified facilities at any time, to assure that the prescribed standards of workmanship are being maintained. The Regulator also reserves the right to inspect these plants at will.

We were impressed with the competence and professionalism displayed in the tank car fabrication process. We were particularly impressed with the Procor Limited manufacturing plant in Oakville and the way they maintained their records. At that plant, we viewed complete computerized records of all the tank cars that have been manufactured or repaired by that Company, and had an opportunity to witness their fabrication, quality control, testing and repair facilities in action. We thank them for their courtesies and for the frankness with which they discussed the topic of tank cars and tank car integrity. We believe this information assisted us greatly in our deliberations on the topic of 'tank car indestructibility'. We will be discussing this in more detail shortly.

Tank Car Maintenance, Modifications and Repair

Repairs and modifications to tank car tanks must be carried out in a facility certified by the Association of American Railroads. Any repair or modification must be performed to an approved procedure and reported to the Association of American Railroads on a car by car basis. The Association thus has a complete history of every individual tank car and the work performed on it, throughout its working life. Repairs to the tank car shell must be carried out, inspected, tested and post-weld, heat treated, to a level equivalent to new car standards. Alterations and modifications must have engineering approval prior to work. Any tank car offered to a carrier railroad must have complete and current documentation in the Association of American Railroads' files.

Maintenance of all freight cars is a car owner's responsibility and the standards of a carrier's acceptance of a freight car, and its components, are as stated in the Field Manual of the Association of American Railroads' Interchange Rules. Each car, when received at an interchange point, must be inspected by the receiving railroad for evidence that the car is in "a safe condition for movement" and the "receiving road is to be the judge". The mechanical condition of each freight car is evaluated by the criteria given in Rule 88. This Rule also includes the applicable Canadian Transport Commission's and U.S. Department of Transport's regulations for the inspection of tank cars.

Should a carrier find that any car has developed a worn component through "ordinary wear and tear in fair service", the carrier has the mandate to repair, or to replace, that component. Such repairs or replacements must conform to Association of American Railroads' standards. Associated costs are submitted to the car owner for reimbursement. The Office Manual of the Interchange Rules contains all the repairs that can be so authorized - complete with a respective cost amount that has been agreed to between all members of the Association of American Railroads.

Should a carrier detect an unsafe condition in any tank car component, other than in the running gear equipment, the carrier is required to inform the owner. These tank cars are then taken to a suitable authorized repair facility for repair. The majority of tank cars in North America are leased. These leasing companies maintain a network of repair facilities across the continent. It is general practice to bring a 'bad-order' tank car to a home shop for repairs to the tank and appurtenances. It is also usual, during the subsequent down time, that a thorough inspection be made of every component of the tank and appurtenances.

Major repairs to the tank shell or heads required as a result of a collision or accidental damage are generally carried out by the original car builder, or a facility that is approved by the Association of American Railroads for new car construction. The applicable repair procedure must be as approved by the Association's Tank Car Committee prior to repair. In such cases, the specifications for new car fabrication are in effect with regard to materials and workmanship. The repaired tank must be inspected and tested, as specified, with the overall intent that the tank, when repaired, shall be the "full equivalent of an undamaged tank."

We were advised that, while all repairs must be made in Association of American Railroads' certified repair shops, the expertise resident in many of the smaller plants, mostly located in the USA and not specializing in the design and fabrication of tank cars, is somewhat suspect. This concern was expressed by the Association of American Railroads' Tank Car Committee itself, and is of concern to us. The Association indicated that it had been unable to apply sufficient resources to correcting the problem to date but that it was readdressing the concern with renewed approval procedures, checks and controls.

Since repaired tank cars can find their way into Canada, and into the Greater Toronto Area, and since the integrity of a tank car, whether repaired or not, is an important component to public safety, a concerted and immediate effort must be applied to ensure that all repair shops meet required specifications, and that repair workmanship be of the highest quality.

We recommend therefore that:

- **Effective controls and procedures be implemented by the Regulator to ensure that all repairs on tank cars operating in Canada, and more specifically in densely populated urban areas, be of the highest quality and integrity; and that**
- **Considering tank car repairs are carried out at shops in both Canada and the USA, this be a subject for the International Joint Railway Commission previously recommended.**

Tank Car Research and Development

Major research and development efforts in tank car technology have focused on improving the integrity of tank cars in accidents.

We believe these efforts have been successful to date, as evidenced by the tapering off of the product release rate as a percentage of derailed cars using improved equipment and retrofits, up to certain speeds. (See Exhibits 4.6 and 4.7.)

A recent Association of American Railroads and Railway Progress Institute research project covered every aspect of tank car technology related to the integrity of the tank shell and fittings during accidents. This was followed by a series of proof-positive tests to determine if increased safety factors were, in fact, achieved. No other agency or organization has ever undertaken a program of this scope or of such interrelated complexity.

In the interim, the U.S. Department of Transport has conducted parallel research efforts in the fundamental behavior

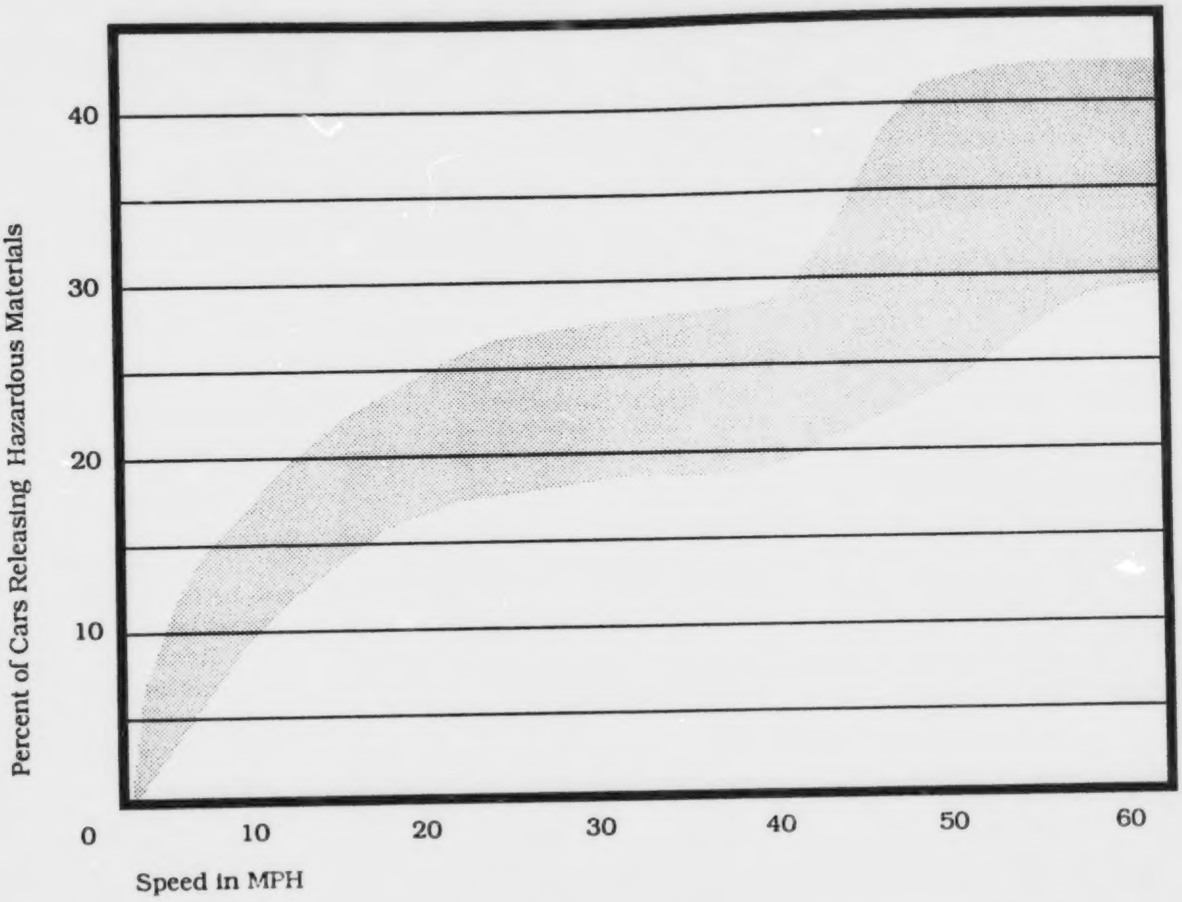


Exhibit 4.6
Percentage Range of Cars Damaged or Derailed that Released Hazardous Materials in Mainline Derailments by Speed 1978 - 1986

of tank car safety valves under extreme conditions. Projects were also initiated in the various aspects of increased safety in railway transportation, including such topics as operational procedures; employee training; the general field of risk-assessment and management; and the application of advanced electronic systems incorporating microchip devices. An example of this technology is the 'radio bolt' device, that would be inserted into wheel bearing end caps, and which would signal the onset of overheating. This device is being developed by the Shaker Research Corp. under US Federal Railway Administration sponsorship.

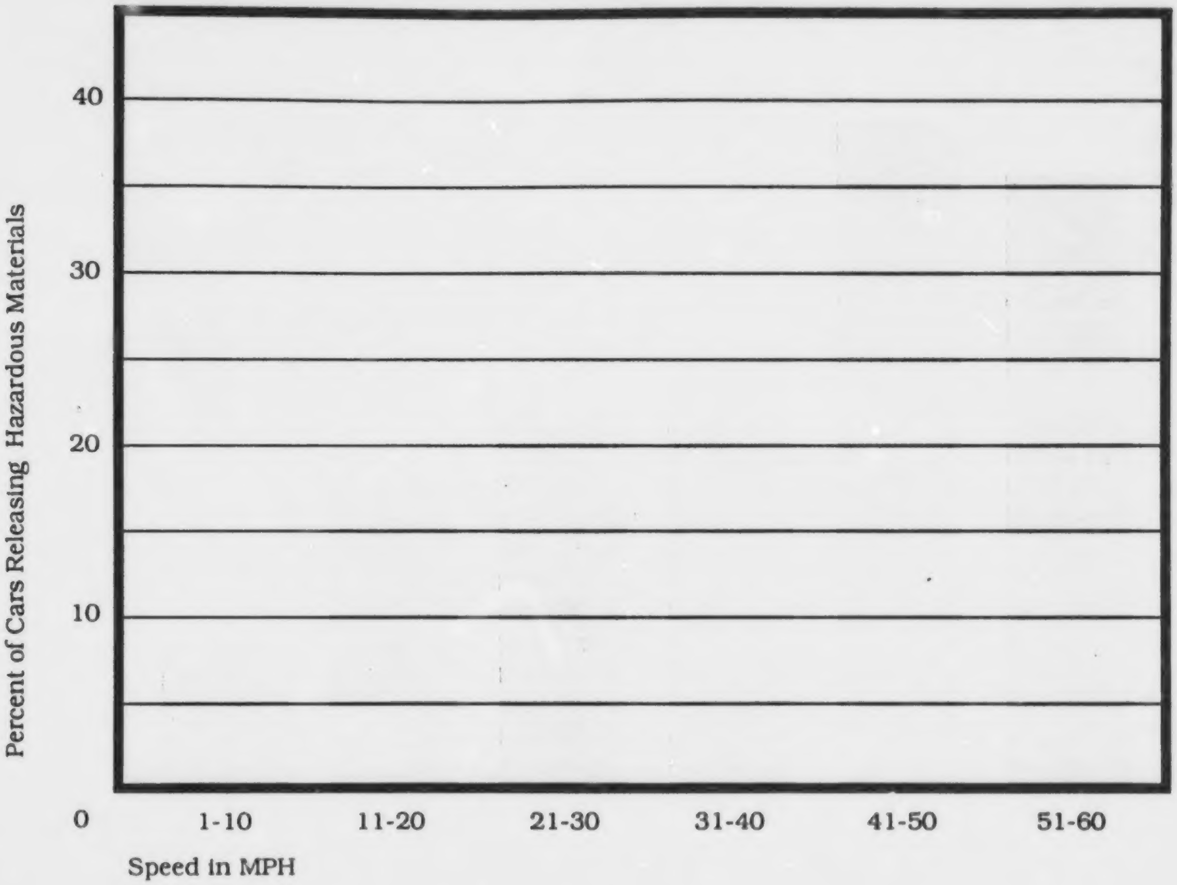


Exhibit 4.7
Percentage of Cars Damaged Or Derailed That Released Hazardous Materials in Mainline Derailments by Speed
1978 - 1986

The Indestructible Container

In an 'indestructible container' all components would have to be designed to counteract the most severe effect of accidents. If the indestructible container definition was to be taken literally, this would involve using significantly thicker steel in the tank shell and reinforcements within the tank body and head-ends, such that all impacts, including the unusual forces applied during a roll-over, would not lead to tank penetration.

The weight of such a car would be enormous. Given the maximum load limit for which the rail tracks are designed, more of these cars would be needed to transport the same quantity of load. Increasing the number of tank cars would result in a greater risk at loading and unloading terminals, as well as in higher transportation costs.

While there is no doubt that an indestructible container could be made, a reasonable balance must be struck between safety on one hand, and the cost of safety on the other. Exhibit 4.7 indicates that the tank car improvements appear to be working up to the 40-45 mph range. Considering that Special Dangerous Goods trains are now restricted to 35 mph in densely populated urban areas, it would seem that such a balance may have been achieved.

We viewed a video on British efforts to develop an indestructible container for carrying nuclear wastes on their railways. Despite impressive demonstrations, and the scientific evidence that no significant leakage had occurred, some doubt in the minds of the public remains and may never be allayed. The fact that some members of the public may not be convinced of the indestructibility of tank cars does not remove, in our opinion, the need to continue improvements to these vehicles.

While we believe that a responsible approach has been taken by the Regulator with respect to tank shell thickness, and by industry with respect to tank car design and design review, efforts should continue to seek ways of improving the survivability of tank cars in railway accidents.

The US Federal Railroad Administration says there is little support for further research and development within the Tank Car industry. The industry has already carried out extensive research and development in the recent past to assure themselves that they have a safe tank car. They now believe they do. As a result, the Federal Railroad Administration must fund more research and development in those safety areas in which they have particular concerns.

The industry's attitude is understandable. But in the interest of public safety, if the Regulator has concerns, such concerns should be addressed.

Research and development experts at the Association of American Railroads' Transportation Test Centre in Pueblo, Colorado are also concerned about the need for tank car research, especially into the effects of various loading distributions on the cause of accidents.

The Task Force is concerned that safety research and development in this area might be curtailed just at the time when the need to continue seems apparent to expert researchers. We feel that tank car safety research and development is an area that the Regulator in Canada, in conjunction with the US Regulator, must be prepared to support financially.

We recommend therefore that:

- **Research and Development efforts into ways and means of further improving the crash resistance capabilities of tank cars carrying dangerous goods be vigorously pursued; and that**
- **The Minister of Transport, working in conjunction with the US Regulator (thereby recognizing the cross-border implications of this effort), provide financial support to the specific area of tank car Safety Research and Development.**

4.5.C Train Operating Improvements

Train Marshalling

General

The 1979 Mississauga accident investigation gave great prominence to the entire question of train marshalling, particularly in regards to the placement of tank cars carrying different dangerous goods.

At present, both Canadian railways place heavy (full) and light (usually empty) cars at random anywhere in the train length. This random placement in the judgement of our consultants, may increase the number of cars derailing per accident as speed increases, because of the immense forces and weights of heavier cars pushing lighter cars out of the way. This is illustrated in Exhibit 4.8.

National Transportation Safety Board officials in Washington, DC, indicate that this is also of concern to them. The Cottonbelt Railway, an affiliate of the Southern Railway in California, recently completed a marshalling study, and concluded that marshalling 'heavies' in the front of a train can reduce the number of their cars derailing. They implemented the practice, and achieved a reduced severity of accidents for their railroad.

During our enquiries worldwide and during our Chairman's discussions with British Rail, we learned that this topic was also of concern and interest in other jurisdictions. British Rail presently has a study underway examining the entire issue of train marshalling. While research is incomplete, there are apparent benefits to marshalling the 'heavies' in the head end of a train.

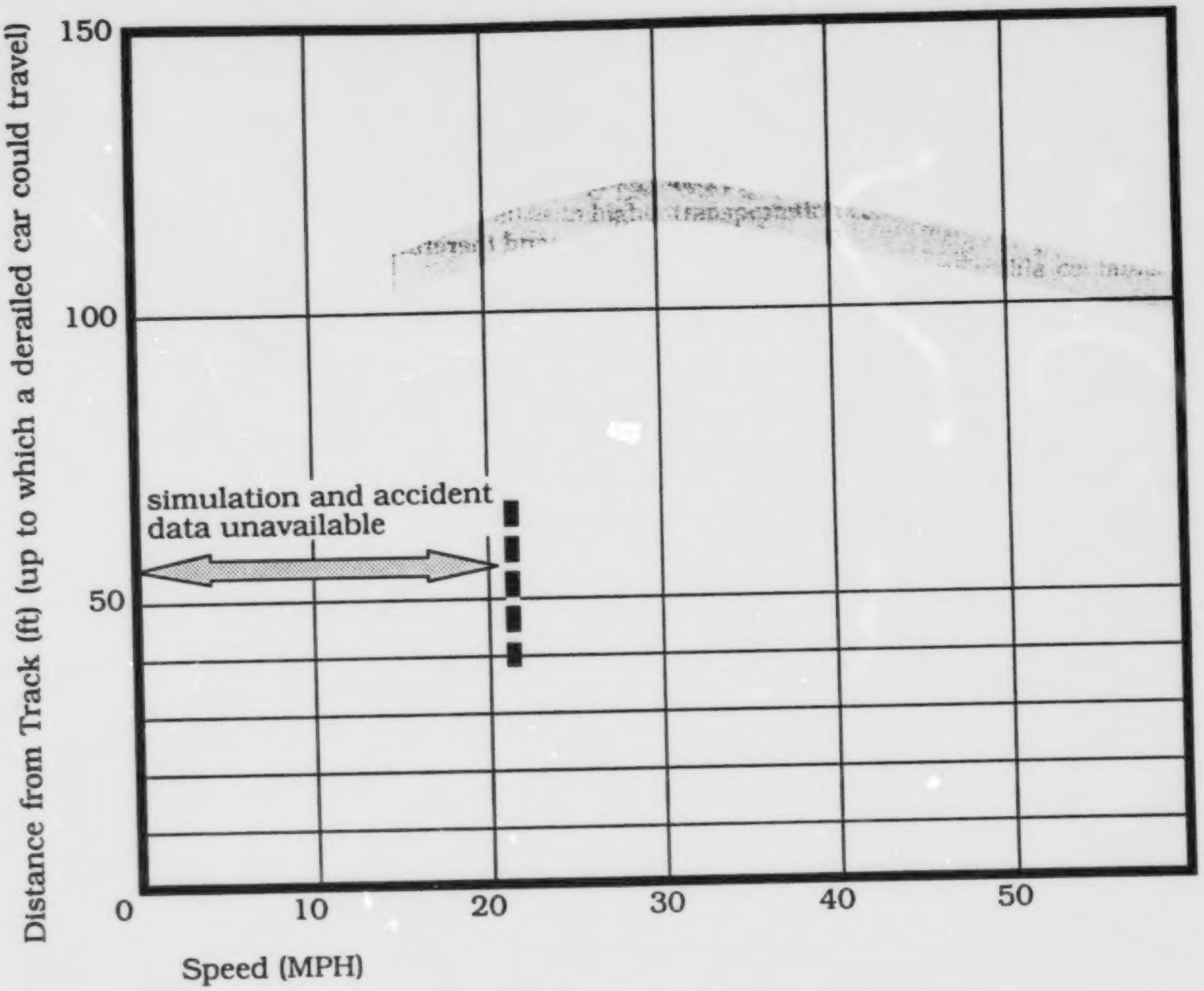


Exhibit 4.8
Effect of Marshalling on Accident Configuration at Various Speeds

We therefore recommend that:

- **Where practicable (as defined by the Regulator after consultation with the railways), heavier rail cars be marshalled at the head end of a train; and that**
- **Research efforts, by the Regulator and by industry, into safe marshalling practices, be emphasized and promoted with vigour.**

Dangerous Goods Marshalling

There are regulations which govern the positioning of dangerous goods cars in a train, set out in the Canadian Transport Commission's Regulations for the Transportation of Dangerous Goods by Rail (known as the 'Red Book'). To increase public safety, certain commodities are separated from each other and placed away from the front of trains.

Special dangerous commodity cars are those which contain a load of product, and therefore would be classed as a 'heavy'. The safety requirements inherent in the positioning of these cars must take precedence over our more general marshalling observations made above. However, the marshalling of special dangerous commodity cars and dangerous commodity cars varies from country to country, and is, as stated above, presently under review in Great Britain.

We therefore recommend that:

- **The marshalling and positioning practices and regulations governing Dangerous Goods cars in a train be re-examined;**
- **Until such time as the above re-examination yields a change, the present regulations governing the positioning of Dangerous Goods cars in a train remain fully in force; and that**
- **The British Rail Marshalling Study, when released, be examined carefully by both the Regulator and the Railways for application in Canadian railway operations.**

Train Length

Our consultants advise that the length of trains appears to influence the severity of accidents, in terms of the number of cars derailing. The immense energy forces inherent in a train increase as a factor of the weight of cars, the number of cars, and the speed at which they were travelling.

Exhibit 4.9 illustrates the average number of cars that would derail as a function of the speed and length of train. This Exhibit should be viewed with some caution, however; it does not specifically indicate the relationship between length and speed as a factor of increased car derailments. But logic indicates that both play a part.

The long distances travelled in Canada impose severe economic constraints on Canadian railways which they attempt to alleviate through longer and heavier train. We however recognize that longer trains may increase the probabilities of damage in the event of an accident.

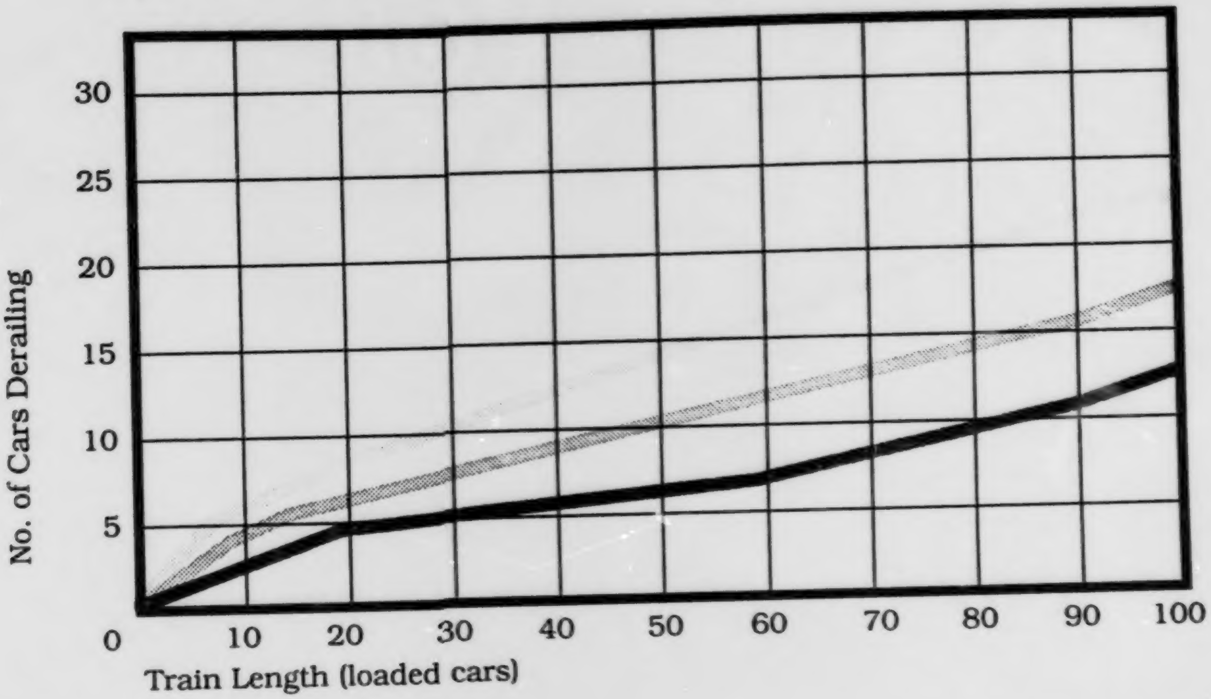


Exhibit 4.9
Effect of Train Length on Number of Cars Derailing at Various Speeds

of damage in the event of an accident.
We therefore recommend that:

- **Studies be commissioned by the Regulator to determine the effects of the length of a train on its propensity to derail and on the resulting severity of an accident. These studies should be aimed at determining if an optimum, yet practical, train length exists.**

Train 'Gateway' Inspections

After the Mississauga derailment in 1979, Justice Samuel Grange's Inquiry, and the 1981 Railway Transport Committee Show Cause Hearings, the concept of gateway inspections was implemented in Canada. These involved an automated monitoring of dangerous goods trains for hot boxes and dragging equipment as they entered into densely populated urban areas. If automated monitoring is not performed, a full manual inspection is required. The Toronto Census Metropolitan Area boundaries constitute the gate-

As mentioned previously, we learned that the new roller bearings had the potential for failing within the presently prescribed 20 mile spacing of wayside detectors. We also learned that the Greater Toronto Area's population growth had pushed development out past the present gateway inspection points.

At the Association of American Railroads' test laboratories in Pueblo, Colorado, certain truck designs are being tested that cannot be read by the present wayside detectors. While these are still at the test stage, we are sufficiently concerned to suggest that the concept of gateway monitoring be kept under constant review and that all efforts be undertaken to improve and enhance inspection or monitoring of trains entering densely populated urban areas carrying dangerous goods.

As an example of such upgrading Canadian Pacific is developing a flat wheel detector. Monitoring devices such as this should be encouraged and incorporated as quickly as possible into the train inspection and monitoring program.

We recommend therefore that:

- **Gateway, and other train inspection and monitoring procedures and practices, be given priority consideration in their upgrading and effectiveness;**
- **The Gateway boundaries, around the Greater Toronto Area, be more frequently reviewed than is now required and altered, as necessary, to accommodate population growth and development;**
- **For economic and safety reasons, effective automated train monitoring be encouraged and promoted - supplemented, where necessary, by manual inspections and monitoring and that**
- **Enhanced, automated monitoring of special dangerous goods trains be encouraged at gateways to ensure that unsafe conditions do not go undetected as they enter populated urban areas.**

The Make Up of Trains (The Consist)

Information on the make up of trains, or the 'consist', is kept on the train itself as well as in the railway company's offices. This listing is compiled differently depending on the railway company. One company starts its listing of cars from the engine end, on the premise that the train engineer would be able to count off the cars as he/she walked back along the train. The other company starts its listing from the tail end, where the conductor or brakeman would be residing.

In the case of emergencies it is imperative that information about the consist be readily available and easily understood by all concerned; there is little or no room for misinterpretations or misunderstandings.

We therefore recommend that:

- **The railways agree amongst themselves to a uniform and standard method of producing train consist listings.**

We would like to acknowledge that our railway representatives indicated that they were prepared to take early action on these recommendations. We are grateful for their quick and decisive response in this regard.

Given that accidents can occur at any time and at any place, we are concerned that, especially in the case of dangerous goods, the train consist listings should accurately reflect the make-up of the train in question.

We therefore further recommend that:

- **The railways seek ways of ensuring that train consist listings carried on trains reflect in as timely and in as accurate a fashion as possible, the true make-up of a train at all times.**

Finally, we fully appreciate that outside first responders may approach a train from either end. There are therefore advantages in having copies of the consist available at both ends of the train.

We realize, however, that there are operational problems in updating a list stored at the remote end of a cabooseless train at other than crew change or inspection points. We also recognize the safety implications involved where this remote consist listing does not accurately reflect the actual makeup of the train. We nevertheless believe that all steps possible should be taken to improve an emergency response situation.

We therefore recommend that:

- **Train consist listings, once operational problems have been overcome, be placed at both ends of a train to facilitate emergency response.**

Residue Cars

From the outset of our deliberations, we heard concerns about residue cars and the fears that they are a threat to public safety. This issue was vigorously debated.

A residue car is defined as one which previously carried a special dangerous product, was unloaded, but still may contain up to 2 per cent of its load. This 2 per cent definition was reviewed and reaffirmed by the Minister of Transport's Advisory Council on the Transportation of Dangerous Goods near the beginning of our mandate.

Our consultants feel that residue cars do present a risk, but only proportional to the load carried. In other words, since residue cars were defined as having 2 per cent or less of their load, the risk from residue cars equated to 2 per cent or less of the total risk. We are of the opinion that the present definition for residue cars is appropriate and we see no reason that they should be subjected to the more stringent operational requirements demanded of loaded special dangerous commodity cars. (It should be noted that one member of the Task Force does not agree with the conclusion that residue cars should not be subject to more stringent operational requirements.)

We are concerned with those residue cars in which another product, such as a pressurized gas, has been introduced to assist in unloading the original commodity. In these cases, the residue car definition is somewhat more problematic. We were also concerned with the inability to determine, in an accurate fashion, whether 2 percent of the pressurized load actually remains or not. The railways advised us that they do not have the ability at this time of checking this quantity.

We recommend therefore that:

- **The Regulator, the railways and shippers develop procedures and mechanisms to measure accurately the dangerous goods residue remaining in unloaded pressure tank cars.**

Leakers

There are concerns over the risk posed by dangerous goods cars which leak. Leaking can occur from a defect in the structural integrity of the car itself, or when the volume of the product expands and spills out of the tank car. It may also be caused by overfilling, accidental spillage or human error.

In the case of structural defects, the situation is extremely serious and immediate steps must be taken to rectify the situation. In the latter cases, these often result from errors in the loading procedures and in situations where a product has moved from a cold to a warm climate. Regardless of the cause, the leak must be stopped and the situation rectified.

The majority of dangerous goods incidents involve leakers. We examined the loading and unloading procedures used by shippers, and were impressed with their efforts to make these procedures safe. We nevertheless urge a constant and continuous caution in the handling of special dangerous and dangerous commodities since one errant action can have serious consequences.

We recommend therefore that:

- **Current procedures and practices involved in the loading, hauling and unloading of dangerous goods be reviewed including the degree to which all personnel (both shippers and carriers) handling these products are adequately trained, alert, and aware of the consequences of their actions; and that**
- **Current regulatory requirements be strictly enforced and repetitions of discovered leakage caused by poor handling at loading and unloading stations should bear heavy penalties.**

4.6 Human Factor Improvements

4.6.A General

Today fewer accidents are caused by technology. As technology improves, fail safe systems become more common, and triple or quadruple redundancy is built into plants and equipment. As a result, human failure is more pronounced and exposed.

This applies to all facets of our society and not just to the Canadian railroads. Mr. Bernard M. Deschênes, former Chairman of the Canadian Aviation Safety Board, indicated that the human factor is becoming a major and dominant cause of accidents in the skies.

We have read and heard of spectacular rail accidents, both in North America and elsewhere, attributed to human failure. We heard and read many submissions and presentations that emphasized the need to pay particular attention to this subject

We viewed several videos and documentaries which discussed the problem of 'techno-apathy'. As technology improves, the human is relegated more and more to a monitoring role. But over extended periods of time, the human becomes a poorer and poorer monitor — as reliance on technology leads the human into complacency.

There are two schools of thought on how to deal with this problem. One approach is to have technology replace the human element completely. The other is to find ways and means of incorporating and involving the human element into the system in such a way as to ensure an alert, productive, aware, and satisfied human being. On balance, we believe that we are far from the stage when machines can replace totally the analytical and value judgements performed by the human.

An alert, well-motivated, medically-fit, properly skilled individual is needed to operate a train of dangerous commodities through densely populated urban areas. These characteristics also apply to the men and women of the maintenance crews, as well as those manning the dispatch units, and the detector analysis functions, to name but a few.

4.6.B Improving the Human Factor

Mandatory Rest Periods for Train Crews

The subject of mandatory rest periods was dealt with by Justice Foisy in his review of the Hinton, Alberta collision, and decisive action was taken by the Minister of Transport in directing that mandatory rest periods be implemented by Canadian railways. We fully support this action because it significantly contributes to an increase in public safety.

Because of this corrective action, we did not explore the subject of mandatory rest periods in detail. However we did debate the merits of ensuring that train crews handling dangerous goods through densely populated areas be fully rested and alert. Just as hot box and dragging equipment detectors are established in designated urban areas, there should be some sort of check on the human component of the system to ensure full alertness and capability.

Of course, the technological solution applied to hot boxes can not be applied to the train engineers and crews. We nevertheless feel that a greater awareness of and sensitivity to the consequences of dangerous goods accidents would benefit public safety. Given that an urban area involves a greater complexity of track layouts, switches and an interfacing with the community and its road system, and that train handling needs to be carried out with more finesse and skill at lower speeds, maximum alertness is required by the crew in these circumstances.

We recommend therefore that:

- **To the maximum extent possible, steps be taken to ensure that fully alert crews are in charge of dangerous goods trains.**

Third Party (Regulator) Licensing of Railway Personnel

In Canada railway personnel are the only major transportation staff not licensed by a third party. Airline operating personnel are tested and licensed by Transport Canada. Ship crews are licensed by the Federal Government. Car and truck drivers are licensed by their respective Provinces. To be fair, the railways are also the only mode to operate on their own 'private' rights-of-way, and the railways are already a highly regulated industry.

When we examined this topic of licensing, we were seeking ways to enhance public safety and public confidence. Our initial view was that the singular act of awarding a piece of paper (a license) by a regulatory agency, might have some perceptual benefit, signalling that:

- since the Regulator awarded a license, the Regulator must be satisfied with the skills level acquired by the person being licensed; and
- the railways were brought under the same licensing umbrella as the other transportation modes.

We also considered the merits of a special Dangerous Goods license attesting to a higher level of skill in train handling needed for these types of train.

However, we did not want to recommend courses of action solely for superficial, or perceptual, reasons. We needed to be assured that real and tangible benefits would be achieved. Our examination of the railway operating personnel licensing process showed that while the actual 'certificate' was awarded by the railways, training programs, exams and tests were clearly spelled out by the Regulator.

In addition, we fully recognized the interchangeability of train crews. Dangerous commodities comprise only about 6 per cent of the total volume of car movements, and train consists change from place to place. It would be difficult to ensure that a train engineer specifically licensed to handle dangerous goods would be in charge of a DG train entering a densely populated community. The solution either becomes an extremely complex crew scheduling exercise, or results in all train engineers being so licensed.

The railways' safety record attests to the fact that the technical skills training of train crews is already of a high standard. To demand a higher level of licensing for dangerous goods only would be operationally impractical. In addition, for the Regulator to take over licensing it would need the capability to test all train engineers. This would be a costly proposition, with no tangible benefit.

The Regulator is already deeply involved in specifying skills training for trains crews and establishing pass mark standards. It already has the authority to check that these processes are in place and functioning properly. We are convinced that independant licensing, simply for the sake of handing out a piece of paper or simply to ensure that the rail mode conforms to other modes, is not justified. However, the Regulator must be assured that the skills acquired by train crews handling dangerous goods are of the highest order, and the way this assurance is given can be varied. As the Regulator moves from 'regulation by specification' to 'regulation by performance standards', the issue of licensing may need to be revisited. In the meantime, we are satisfied that the present process employed by the rail industry does not impact public safety adversely.

Medical Checks For Railway Operating Personnel

We studied the issue of medical examinations for railway operating personnel, and compared such examinations with those for air pilots. In each case specific requirements and procedures have been established.

Medical checks play an integral part in the safety commitment of the airlines and their Regulator. Through the regulatory control and monitoring exercised by Transport Canada, pilots must have annual or semi-annual medical checks involving specific and prescribed testing by approved doctors. These are subject to scrutiny, and double checked by Transport Canada's own doctors.

The process established for the aviation mode, while perhaps not perfect, goes a long way to establishing within the minds of the flying community and the general public that being medically fit is essential for safe flying. The independent third party checking of this medical process, and the fact that medical fitness is a requirement for gaining and keeping one's pilot license, results in a more compliant and responsive pilot population.

We are convinced that this process contributes to public safety and public confidence. The public should be made aware of the fact that railway operating personnel undergo a similar process.

We recommend therefore that:

- **Railway operating personnel continue to be required to take medical examinations at prescribed times and in a prescribed manner as a prerequisite to maintaining their licenses;**
- **The process of medical examinations for railway operating personnel be reviewed with that in place for the aviation community to determine areas for improvement (if any); and that**
- **As an assistance to improving public confidence in the railways, the public be made aware that train operating personnel do undergo prescribed medical examinations.**

Mandatory Drug/Alcohol Testing

We are keenly aware of the controversy surrounding this sensitive issue, and the growing attention it is given by the public, industry, governments and the media. Since it is clearly a safety issue, we felt strongly that we had to provide some input to the debate.

We invited the Addiction Research Foundation of Ontario to brief us on the topic. We reviewed the Price Waterhouse survey recently issued to the Minister of Transport entitled "Task Force on the Control of Drug and Alcohol Abuse in the Railway Industry - Survey of Persons Employed in Positions Critical to Railway Safety (October 1987)". We discussed the issue with the Research and Special Projects Administration in the USA. We examined the present processes in place to deal with the subject of drug and alcohol use or abuse in both railways and in regulations. Finally, we debated the issue vigorously amongst ourselves.

When human error is detected or even suspected, in a rail accident as in a motor vehicle accident, one of the first issues raised is whether drugs or alcohol were in use. Many submissions to the Task Force raised this issue and asked that something be done about it.

We recognize the difficulties in balancing the safety of the general public against the rights of the individual. We acknowledge the position taken by the Human Rights Commission and the statements made by Canada's Minister of Health against the mandatory testing of employees. We also acknowledge the growing trend towards mandatory testing in the United States and in corporations having operations and functions which can affect public safety.

Addiction Research Foundation scientists advised us that, contrary to media reports, the accuracy of testing for the presence of drugs, as well as for determining the types of drugs used, is extraordinarily high if performed in a reliable laboratory. The difficulty lies not in the testing processes, but in determining impairment. There is a relatively straightline relationship between alcohol usage, blood sugar elevation and impairment. As well alcohol dissipates out of the blood stream at a relatively predictable rate. Because of this predictability, a specific level can be established for the roadside tests conducted on automobile drivers. The situation is different for other types of drugs. Blood sugar elevations and impairment do not seem to go together in the case of non-alcoholic drug usage, and thus degrees of impairment are difficult to establish and prove.

In the case of non-alcoholic drug usage, impairment seems to come about only after the blood sugar levels have started to return to normal. Thus it could be possible to test for blood sugar elevations; get a normal reading; but still have an impaired person. On the other hand, traces of drugs tend to remain in the human system for lengthy periods of time, leading to the possibility of testing a person; finding traces of drugs from some not-too-distant period in the past; yet not have an impaired person.

This evidence, and our deep concern about the possible effects of drug/alcohol impairment on public safety, was the object of considerable discussion. We considered the high degree of drug and alcohol usage reported in the Price Waterhouse survey, which coincides with similar findings in the United States. We reviewed Rule 'G', in the railway regulations, which states that no drugs or alcohol will be used on the job whatsoever, and that such usage is a dismissable offence. We also consulted the Unions for their views on the subject.

Mr. R. Bennett, General Chairman of the United Transportation Union, stated that the Union membership was in complete agreement with Rule G and were favourably disposed to testing for reasonable cause. He also felt that Union membership supported testing after a serious accident. Mr

Bennett stated, however, that testing would be acceptable only if the membership could be fully assured that the testing processes were accurate, fair and reliable. Mr. Bennett also indicated that he would be opposed to random testing because he believed it was an infringement on basic human rights.

We were briefed on the pre-employment drug testing process employed by the Canadian National Railways and the Canadian Pacific Railway, and heard about the results from a similar exercise underway in the U.S. Navy. Finally, we were concerned to hear about the reluctance of fellow employees to 'turn-in' a colleague and we listened with interest at the successes being achieved by Employee Assistance Programs.

Unlike their aviation counterparts, where commercial pilots interact with many persons in an airport setting before boarding and piloting a plane, train crews often change in remote and isolated places at all hours of the day and night. Train crews changing in remote locations are required, under existing regulations, policies and procedures, to sign themselves in, attesting to the fact that they are capable of operating a train safely. This practice, we believe, is open to abuse and as such could impact on public safety. Recognizing the technological advances inherent in reset buttons installed in train cabs and the further safety innovations planned in the Advanced Train Control System, we nevertheless encourage further means of ensuring the full alertness of all train crews, at all times. This should especially be the case through densely populated areas and more especially when dangerous goods are being transported.

We believe that there exists fairly strong support for testing for 'reasonable cause', provided that such testing respects the right and privileges of the person being tested. We also believe that strong support exists for testing after a serious accident has occurred. We are in support of both these measures.

However we believe that additional steps should be taken. Pre-employment testing not only catches some potential problems in advance, but more importantly acts as an effective deterrent to a significant percentage of those who use drugs/alcohol excessively and who might apply for safety related positions in the Canadian railways - whether they be new employees or employees seeking a new position.

More effective use and promotion can be made of Employee Assistance Programs. Railway employees, especially those who operate dangerous goods trains in densely populated communities, should be strongly motivated, through training and refresher courses, responsive video programs, poster programs, and the like, to ensure that drug/alcohol usage, by one's self or one's fellow employees, is stopped. We strongly support the continued enforcement of Rule G, and encourage ways and means of preventing drug/alcohol useage before it starts. In this regard, we would suggest that the medical checks mentioned above include specific tests for the use of these substances.

We recommend therefore that:

- **Rule G, specifying the non-use of drugs or alcohol on the job, or when subject to duty, be maintained and strongly promoted;**
- **Properly advertised pre-employment screening tests for new employees and for those seeking a reclassification to safety related positions be implemented;**
- **Testing for 'reasonable cause' also be implemented but with assurances that employee rights and privileges are not abused. (Reasonable Cause to be defined by the Regulator in collaboration with the railways and the railway Unions);**
- **Mandatory testing for drug or alcohol usage be undertaken in the case of serious accidents involving death, injury, derailment or collision;**
- **Employee Assistance Programs be promoted and encouraged along with a training program to increase railway employee awareness as to the seriousness of the consequences of impaired actions, especially involving dangerous commodities; and that**
- **Medical checks on employees involved in safety related positions, such as train engineers, include tests for the abusive use of drugs and alcohol.**

Human Factor Research and Development

Even though we commented to some extent on Research and Development in the Chapter on Public Safety, we feel it is appropriate to expand on it here as it affects the Human Factor.

Quite frankly, we grew more and more amazed that research into how the human element interfaces with the technological aspects of the railway system has been virtually ignored until very recently, both here in Canada and in the United States.

Technical training given to railway personnel is of a high quality. But this is not what we are talking about. When we refer to the human factor and how it interplays with the other components to ensure an efficient, effective and safe railway system, we are concerned with understanding what makes railway operating personnel do what they do; what causes undue stress; what generates the highest productivity; and what produces the safest rail system environment.

With one or two exceptions, we were unable to find any concerted effort or dedicated research program which was even considering the interface between the human element and the railway system.

We did however, uncover a few exceptions. One of these was in Britain, where British Rail researchers have realized that they have to view the railway system as an integrated whole and all research now takes the human factor into consideration. British research into such matters as ergonomics in the train cabs and the effects of train crews on train handling is underway. This led us to another extremely important observation on the whole topic of ergonomics in the train cab. We were somewhat surprised to visit train cabs and witness how little they appeared to have changed over time. To the non-railway members of the Task Force, they represented spartan places of work. We acknowledge that locomotives last many years and to effect meaningful changes in this environment would require the involvement of both the railways and the manufacturers. We are however of the opinion that this is an area where experts, familiar with the field of ergonomics, should be more fully employed, in new design and in retrofit programs.

We were pleased to learn that the railways have taken significant steps in this direction and that new cab designs presently underway incorporate this 'ergonomic' principle.

The other place where the human factor is being considered, to a certain extent, is in the Advanced Train Control System development undertaken by the Canadian railways. We were pleased to see during our visit to the Canadian National Railways' Training Institute at Gimli, Manitoba, that a human engineering expert was part of the Advanced Train Control System project team, and that consideration was given to ensuring the best possible fit between the human element (the train engineer) and the new technology. We were also pleased to note that the development of the Advanced Train Control System computer programs were involving the operating personnel. This latter demonstration we witnessed during our examination of Canadian Pacific facilities in Toronto.

Recognizing that the human is an integral part of the total system in operating railroads, and that the human has certain strengths and weaknesses, it seems to us absolutely vital that this part of the system be acknowledged and that research be undertaken to explore better ways and means of overcoming human deficiencies.

We would like to emphasize that by human factors research, we are not just talking about developing more and more technological ways of replacing the human in the system. We are suggesting that research should be aimed at finding out what is causing the human component to fail in the first place, and then to suggest ways for getting the human to overcome these weaknesses and remain a vital, productive, aware and alert component of the rail system. It is our earnest belief that dollars channeled to this research will greatly enhance public safety.

We strongly recommend therefore that:

- **The human component of the rail system be recognized as a vital and integral part of the total railway system;**
- **Railway manufacturers, Management and Unions, in any new train cab development or retrofit program, take ergonomics and the human element into consideration;**
- **Research resources be applied to understanding the functioning of the human component; and that**
- **All research, whether human factors or technological, take the impacts on the total rail system into consideration.**

Training

One of the critical characteristics of railway personnel is how well they are trained and how well they apply that training.

To investigate this topic further, we visited the Canadian National Railways' training establishment in Gimli, Manitoba and operated the simulators used to train railway personnel. We examined training manuals and explored the regulations which set out course specifications and pass mark requirements. We visited operating dispatch units, telecommunication offices, and automated monitoring facilities. We took train trips to see how the training was applied and we visited repair shops and railway classrooms. We were greatly impressed with the technical training given by the railways. Despite the different training approaches used, both railways seem to be achieving the desired end result - a declining accident rate and an ever improving safety record.

Canadian National relies more on classroom and simulator exercises, complemented by on-the-job practice, while Canadian Pacific appears to use only classroom exercises, followed by extensive on-the-job apprenticeship before a train engineer is able to perform 'solo'. We are not in a position to judge which method is best. It is results that count, and both methods appear to be effective.

We are concerned, however, by the militaristic manner in which the training is carried out. The railways' feel that the overburden of regulations, and the penalties imposed for an infraction of these regulations, forces them to train their rail crews in a most regimented way. This approach is taken not only in the railway companies' self interest; they genuinely feel that this type of training protects the railway employee as well.

We are sympathetic with the plight of the railways in this regard, but believe that it is not only what is taught that counts, but how one is taught. It is our view, and that voiced by Mr. R. Bennett for the Unions, that technical training in the railways needs to be complemented with motivational training, to increase train crew awareness of the consequences of their actions on the communities through which they drive, and which help increase one's job satisfaction. Mr. Bennett further suggested that greater involvement by operational personnel in the development of course curricula would be helpful, and we agree.

The approach being taken by both railways in developing the Advanced Train Control System does incorporate a number of these motivational factors. This type of involvement by the operating personnel will encourage a reduced resistance to change.

We were shocked to discover that only about one hour's worth of Dangerous Goods classroom training is given. The Dangerous Goods Training basically covers only what to do in the case of an accident involving a dangerous goods car or train, and who should be contacted. After some classroom presentations, a written test is given. No simulations are undertaken. Training in general normally encompasses both classroom and on-the-job training. We were unable to find how on-the-job training is accomplished effectively in the area of dangerous goods emergency response handling.

Railway emergency response personnel are, of course, given greater and much more extensive training, than this '60 minute' exercise for train crews. In fact, the Canadian railways have taken advantage of a three day course at Pueblo, Colorado, the Association of American Railroads' test site.

Given our preoccupation, however, with the ideal of a well-motivated, highly skilled, individual operating dangerous goods trains through the Greater Toronto area, we feel it is important that present technical training courses be augmented by motivational and awareness training and that training courses in the area of dangerous goods and dangerous goods handling be substantially increased.

We recommend therefore that:

- **Railway training programs, already technically of high standard, be complemented with motivational and awareness training;**
- **Dangerous goods handling courses be significantly enhanced to include, for example, an understanding of emergency response systems, and to view, through videos and the like, demonstrations involving the consequences of dangerous goods accidents (i.e. fires, toxic gases, explosions, etc.);**
- **Dangerous Goods courses in addition to the conditions prescribed under the Transportation of Dangerous Goods Act, include an awareness of the consequences such accidents could have on a community;**
- **Dangerous Goods courses, for all railway operating personnel, include simulation and other such testing to help ensure an effective emergency response; and that**
- **All training courses involve operational personnel more extensively, both in course development as well as in instruction.**

4.6.C Conclusion

The infrastructure, rolling stock, signal systems, communications, and the interweaving of these technologies have come a long way. As these technologies improve, the human component becomes more and more exposed as the most vunerable link in the overall system.

For this very reason, and because dangerous goods accidents can have significant and dire consequences — especially in densely populated areas such as the Greater Toronto Area — we urge that greater attention be given to the human side of the system. Insufficient research has been devoted to determining why professionals, such as train engineers, can at times fail to respond properly when the need arises. Efforts made in the area of human factors will be greatly rewarded by a substantially increased level of public safety. We urge that steps be taken to improve this aspect of the railway system.

4.7 Speed

4.7.A General

One of the more controversial topics we examined was the question of speed. We received many submissions and several Municipal Council resolutions, mostly from the Municipality of Metropolitan Toronto area, requesting that the speed of trains hauling dangerous goods be reduced to 25 mph. These requests were supported by the Municipality of Metropolitan Toronto itself and by some Provincial and Federal Members of Parliament representing their constituents in this area.

All these requests were made without any documentary evidence to indicate that 25 mph was a safer speed. We were struck with the uniformity with which most requests had centred on 25 mph as an appropriate speed at which dangerous goods trains should operate.

We commissioned consultants to examine the relationship between speed and both the frequency and severity of accidents. We examined the Grange Inquiry into the 1979 Mississauga derailment; the subsequent Railway Transport Committee's Show Cause Hearings, on the Justice's recommendations; and the Railway Transport Committee decision popularly known as the Burton-Post report. Finally, we sought relevant data on speed protocols in foreign countries.

Our consultants undertook one of the most comprehensive literature examinations ever undertaken on the subject. Their search, totaling over 16 bibliographic pages, was unable to uncover any single study which examined all aspects of the speed question in similar detail. It must be remembered, however, that their study was not a research exercise, but an examination of the existing and pertinent literature.

Our consultants created a synthesis based on Canadian and US data from 1979 to 1985, and on a review of numerous technical and accident reports from research agencies, suppliers, railways, universities and governments. Some North American base data was modified to reflect 'mainline' accidents because our focus was on the mainline conditions in the Greater Toronto Area.

Other data, relating to equipment, was modified to reflect the upgrading of cars equipped with head shields, double shelf couplers, thermal insulation, roller bearings and bottom valve protection.

4.7.B The Importance of Speed

For the Railways, speed means the time it takes to transport a product from one point to another. This in-transit duration translates into economic costs and consumed track capacity which, in turn, raises or lowers the price to the shipper and ultimately to the consumer. In-transit costs, both in terms of dollars and time, are therefore of primary importance in the competitive world of transportation. Naturally, the railways would like to see the speeds as high as a safe operation will allow.

To the communities in which the railways operate, speed is a source of noise, vibration and the predominant factor contributing to the severity of an accident. In their view, lowering speeds is an important component in enhancing public safety.

The question of speed therefore is a highly emotional and politicized issue as much as it is a technical, operational and an economic one.

4.7.C The Question of Frequency of Accidents and Speed

We examined speed in its relationship to both the frequency of accidents and its impact on the severity of accidents.

We wanted to know whether speed was a major contributing factor in the cause of accidents. Our consultants did not find any research showing that speed, within permissible limits, is a pivotal element across the full spectrum of accident causes. There are, however, many studies that examine accidents where speed has a contributing role. Our studies reveal that causes of accidents are primarily attributed to track defects, improper train operations (i.e. dynamic in-train forces), and equipment deficiencies. These causes have been decreasing over time (See Exhibits 4.10 and 4.11), resulting in an overall reduced railway accident rate.

In analyzing the specific causes in more detail, our consultants, determined that certain types of causes occurred predominantly within certain speed ranges, and the majority of causes appear to be concentrated in the lower speed range. (See Exhibit 4.12).

It does not follow, however, that to decrease the frequency of accidents we should require the Railways to increase operating speeds. There are other factors at work. Conditions often force the railways to operate trains at low speeds. These conditions involve factors such as adverse grades or restrictive geometry, and the requirement for speed reductions when approaching yards, interconnecting track, grade-crossings, priority meets, traffic congestion, and so on.

If these unfavourable conditions were removed, we think that accident frequencies, especially in the lower speed

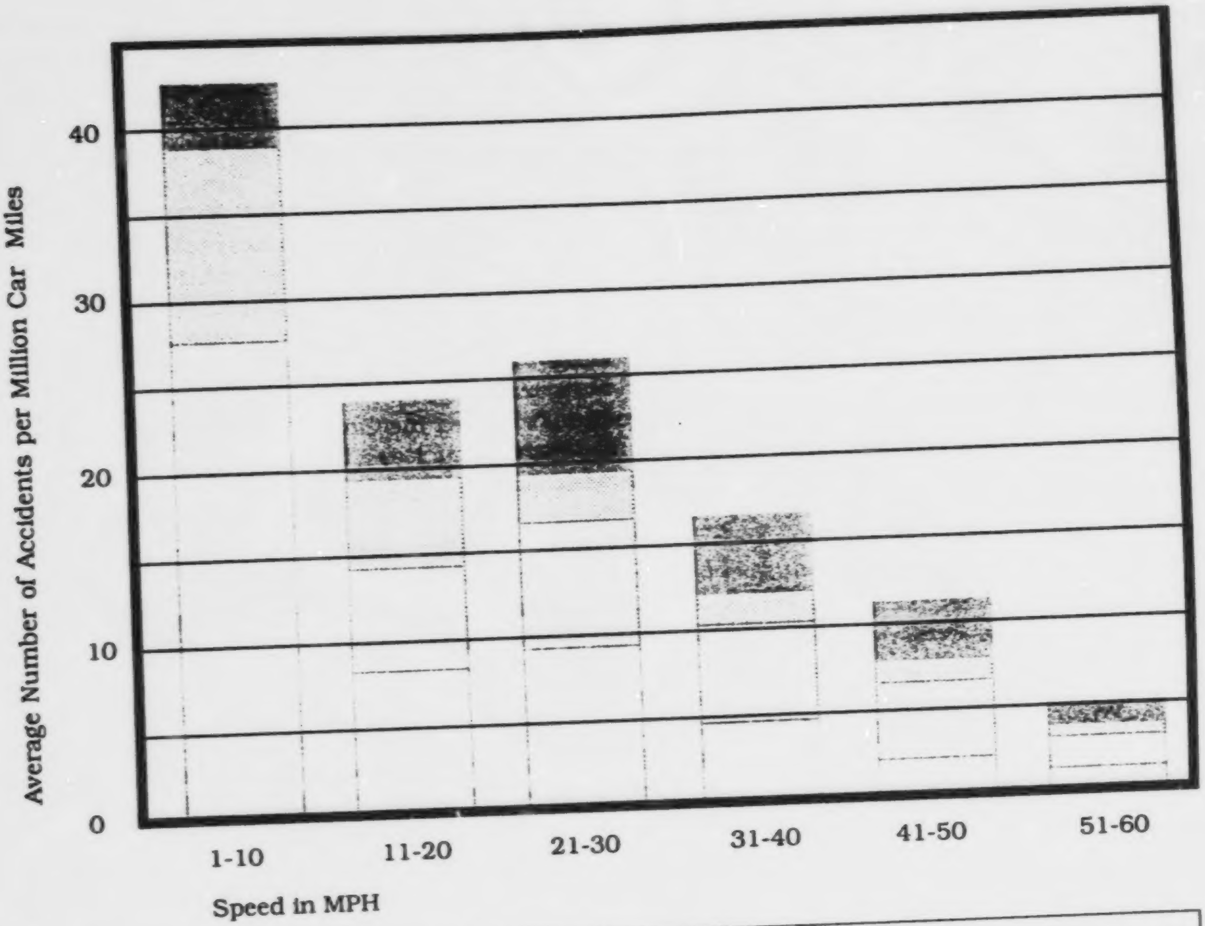


Exhibit 4.10
Average Mainline
Accident Frequency By
Type for Operating
Speed Ranges
1981 through 1985

ranges, would be reduced. Examples of safe operations at high speed are illustrated everyday in the passenger operations of Great Britain and the United States (120 mph); in Japan (130 mph); and in France (160 mph). Where technology and operating conditions are appropriate therefore, speed is a minimal factor in the frequency of accidents. We acknowledge that freight trains are quite different from passenger trains in operating characteristics. We neverthe-

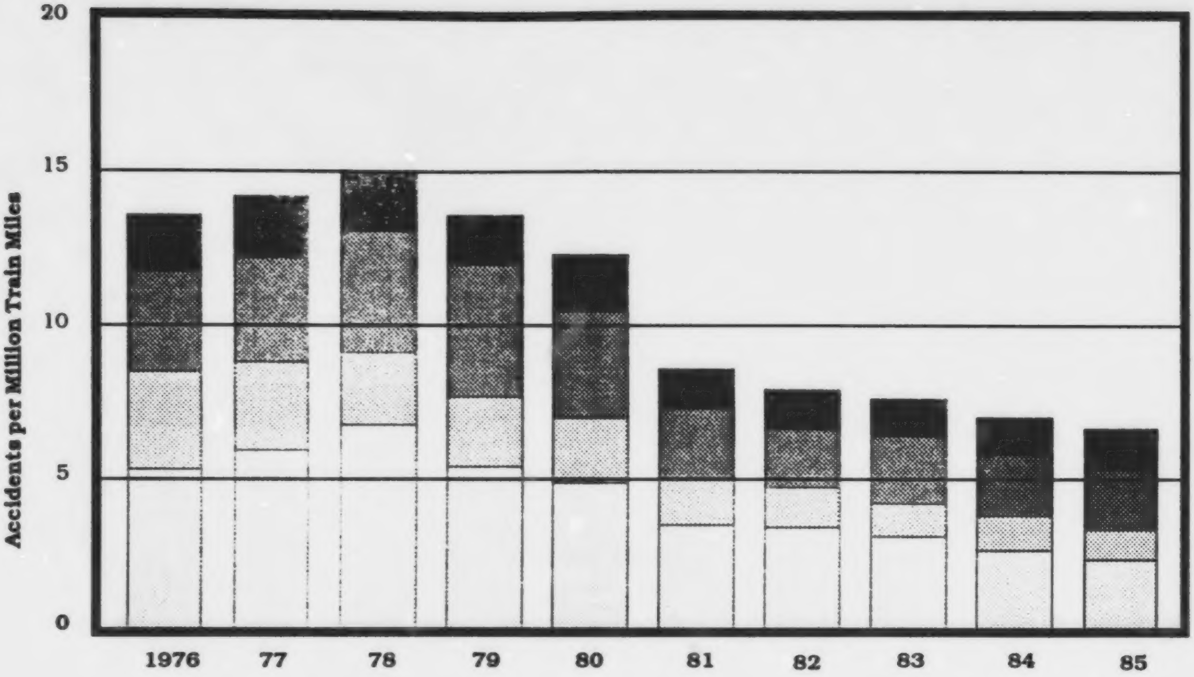
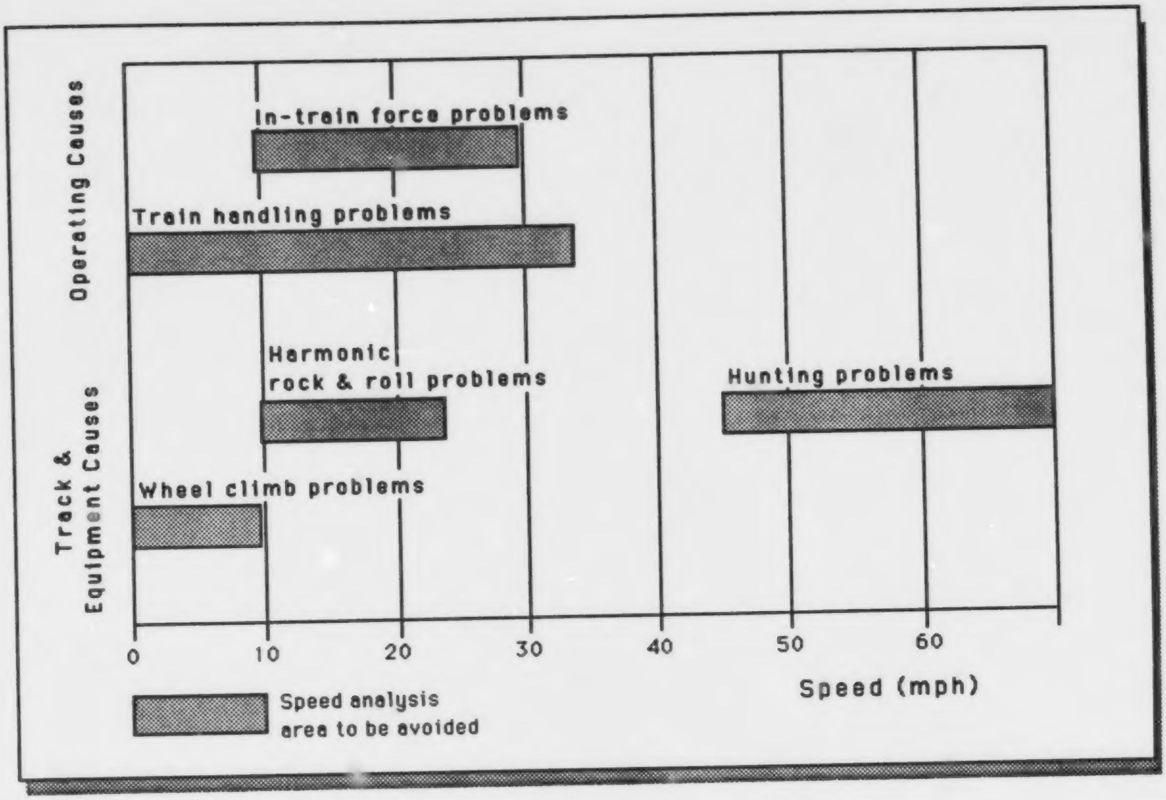


Exhibit 4.11
Historic North American Mainline Accident Frequency of All Types By Year

less maintain that if technology and operating conditions are matched and accommodated, speed is a minimal cause of accidents.

We found no evidence that speed, in itself, is a major causal factor in the frequency of accidents. As it says in a 1985 report of the Canadian Transport Commission on VIA Rail train speeds:

"Speed by itself, does not appear to be a major causative factor of accidents. There are, however, a myriad of circumstances where, if speed was less, an accident may not occur. There are also certain circumstances where, if speed was greater, an accident may not occur. Further elaboration is required.



Exhibits 4.12
Main Line Train Problems
Causing Accidents
By Speed Ranges

▨ Range of Speed over which accident cause mainly observed

"We heard, for instance, that a dominant consideration is the design and condition of track infrastructure. Different designs and conditions are required for different maximum train speeds. Each particular section of track can safely accommodate a certain maximum train speed for a certain type of train. Above that maximum, train operation becomes unsafe. There are no generalities that can be made in this respect."

and further:

"If one assumes, however, that track design and condition is suitable for a certain maximum permissible train speed and a train operates at a speed in excess of that maximum on that track, it appears that an unsafe situation would develop in terms of the risk of an accident - all other things being equal. Given the relationship between speed, track elevation and curvature etc., the faster the train travels above the maximum permissible track speed, the greater the risk of an accident, hence the less safe the operation becomes. All other things being equal however, speed increases up to maximum permissible speed seem to have little, if any, influence on the risk of an accident. There will always be a certain level of inherent risk to the train movement up to the maximum permissible speed and that will likely be relatively fixed below the maximum permissible speed. Above the permissible speed, the rate at which the degree of risk increases with speed increases is an unknown quantity."

Like a car on the highway, if a train travels within posted speeds, on good track, taking weather conditions into consideration, the chances of an accident occurring because of speed alone are minimal. Attention would be better applied to other identified causes of accidents.

4.7.D The Question of Severity and Speed

Our consultants examined the question of severity, in terms of both the number of cars derailing and the number of cars that would release their product in the case of an accident.

In terms of the number of cars derailing, our consultants confirmed the logical and widely-held view that the higher the train speed, the greater the number of cars that would derail. Exhibit 4.13 illustrates this conclusion.

In terms of the release of product, however, the relationship between speed and severity is not as direct. After examining several studies and incorporating investigations by the Association of American Railroads, our consultants found that the percentage of derailed cars releasing product was relatively uniform between 10 and 40 mph, but increased significantly above 40 mph. (See Exhibit 4.14). Discussions with the US National Transportation Safety Board indicate that these percentages may be on the high side since improvements are constantly being made to the integrity of tank cars.

Therefore there is a relationship between the increase in speed and the increase in the severity of an accident in terms of the number of cars derailing. Specifically, our consultants stated: "As applied to estimating consequences for specific commodities, the likelihood of releasing specially dangerous goods must be weighted in proportion to their presence in the train consist. In short, it appears most likely that if a significant portion of a derailed train is made up of hazardous goods, a release will occur. If specially dangerous goods are involved, appropriate safeguards against severe consequences are necessary."

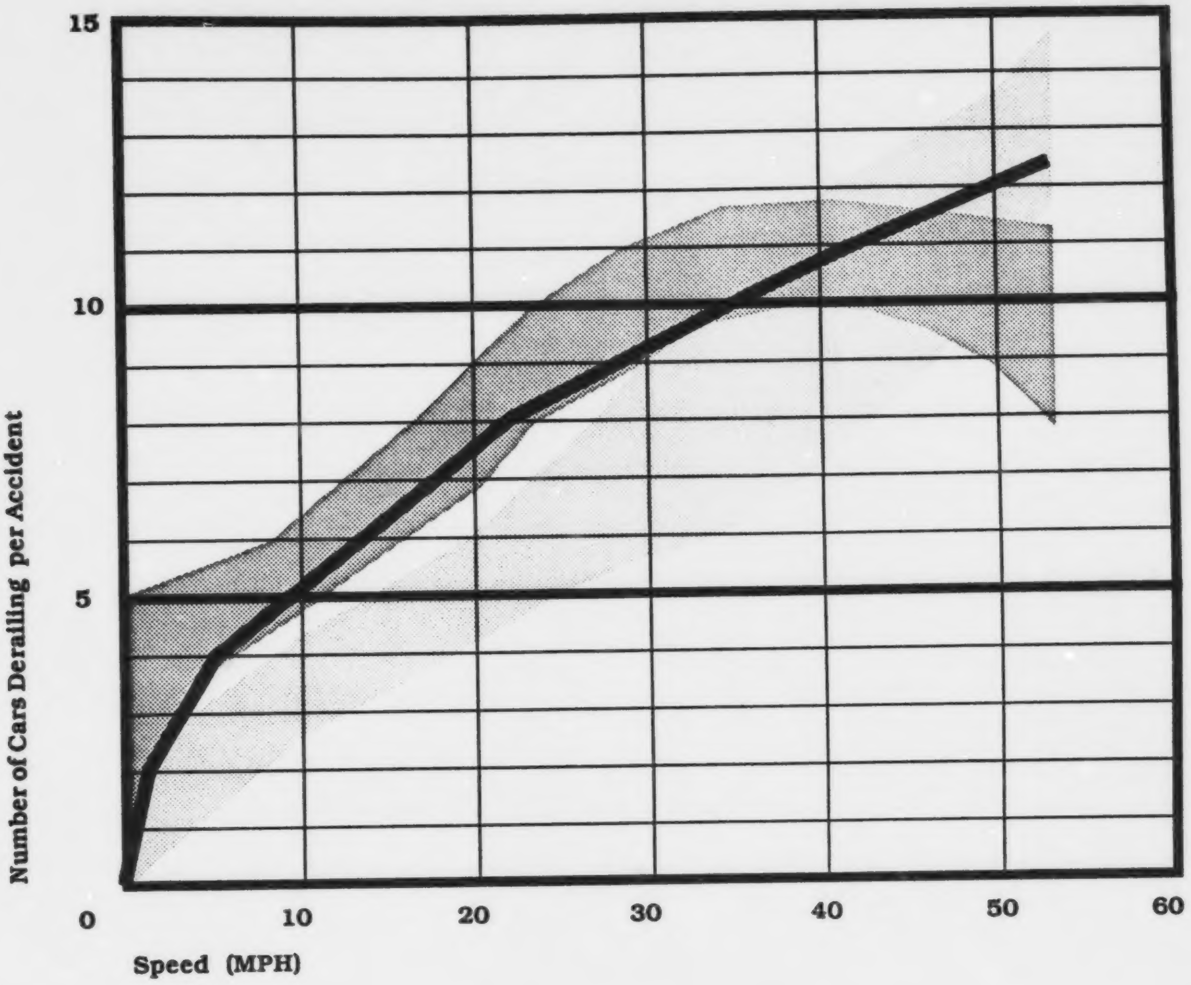


Exhibit 4.13

Relationship of No. of Cars Derailing per Mainline Accident to Speed

(for trains using improved equipment)

Note: Improved equipment = Rail cars having head shield protection, shelf couplers, insulation jackets and roller bearings.

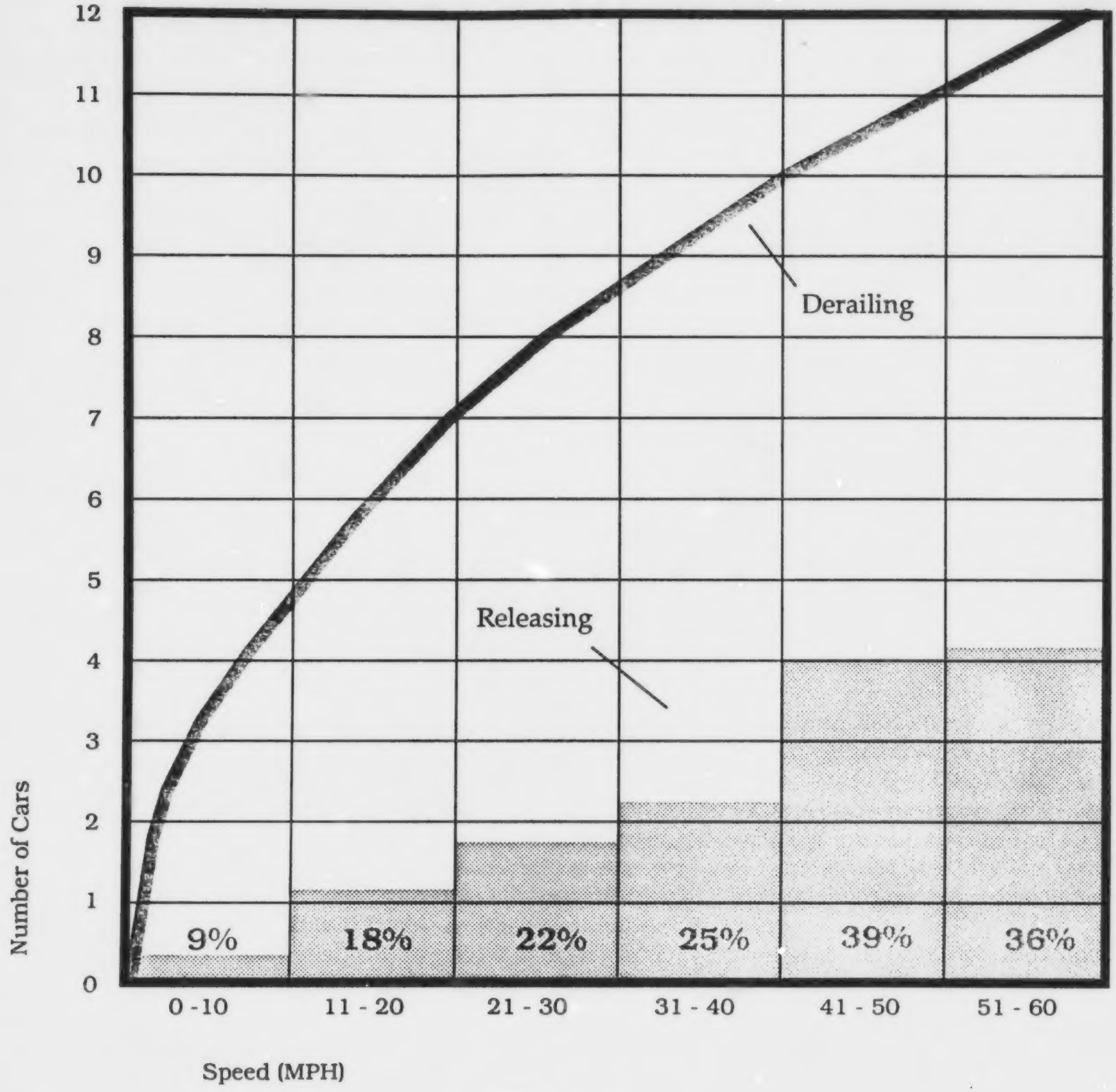


Exhibit 4.14
Number of Cars Derailing compared to Percentage of Cars Releasing Product, by Speed in Mainline Accidents

■ Number of cars damaged or derailing per accident

▨ 00% Number / percentage of cars releasing hazardous materials

4.7.E Speed Change Induced Forces

Some of the most common causes of accidents were those associated with constraints which require the train operator to adjust speed or to use special skills in minimizing in-train forces. Typical situations which cause speed adjustment reactions include braking, traffic congestion, track deficiencies and adverse train priorities. The solution, we believe, is to manage train traffic in the Greater Toronto Area so that speed changes are kept to a minimum.

4.7.F Speed Conclusions

Speed, in itself, is not a major causal factor in the frequency of accidents. Speed does have a relationship to the severity of accidents, although less than generally perceived, at speed ranges between 20 and 45 mph. Causes of accidents primarily relate to track, operational and equipment deficiency reasons. Therefore the preferred approach to the problem of accidents lies in attacking the initial causes rather than trying to decrease the speed of trains.

All but one of the Task Force members have concluded that there is insufficient technical and substantive evidence to recommend any changes to the present regulated speed of 35 mph for trains carrying special dangerous goods travelling in densely populated urban areas.

We do however acknowledge the considerable number of submissions sent to the Task Force on the question of speed reduction, and the intensity of the emotion behind these requests. While the majority of the Task Force is unable to recommend any speed changes based on the evidence presented, we want to record that three members of the Task Force wish to advise of this deep public concern regarding train speeds, and further wish to advise that this concern could be addressed by asking the railways to maintain a reduced speed profile of 25 mph for special dangerous commodities and 35 mph for trains carrying dangerous commodities until the adverse conditions mentioned above have been addressed and agreed to by the Regulator. This minority position further suggests that if these specific speed reductions are implemented, they should apply only to those four high risk areas identified in our Risk Assessment evaluation and previously identified in section 3.8.C of this Report. The high risk areas identified are those segments of track:

- From Weston Road on Canadian National's Weston Subdivision and from Starview Drive on the Canadian Pacific's McTier Subdivision to the West Toronto Diamond;
- From Kipling Avenue on Canadian Pacific's Galt Subdivision to the West Toronto Diamond;

- From the West Toronto Diamond along Canadian Pacific's North Toronto Subdivision to their Agincourt Yard in Scarborough; and from
- Canadian National's McMillan Yard, along their York Subdivision eastwards to Doncaster.

We wish to record further that within the minority position mentioned above, one member of the Task Force would wish to see a mandatory slow order imposed for lines running through Metropolitan Toronto until such time as dangerous goods no longer run on these lines or relocation of these tracks are implemented.

While recognising the differences mentioned above concerning the issue of speed itself, we nevertheless are in agreement regarding the following course of action.

We therefore unanimously recommend that:

- **Since the question of a preferred speed is fundamental to public confidence in the safe operations of trains carrying dangerous goods, an independent, technical review be established to examine our consultants' work with regards to Speed.**
- **Since it has been determined that speed is not the primary or major cause of accidents and since it has been determined that accidents are caused by other factors, attention be given to addressing, and removing, on an utmost priority basis, the track, equipment, operational and track defect causes of accidents as identified by the Task Force's consultants, in the densely populated urban areas of the Greater Toronto Area;**
- **Research and Development work be accelerated into reducing in-train operational forces, harmonic oscillation, wheel climb, hunting and other such causes of accidents;**
- **The passage of trains carrying dangerous goods in the densely populated urban areas of the Greater Toronto Area be more carefully managed and scheduled in such a way as to ensure that they are not required to change speeds abruptly or unduly; and that**
- **To the maximum extent possible, physical, geographic and infrastructural impediments requiring undue speed changes be removed.**

As mentioned earlier, once the Advanced Train Control System is implemented, it will have a significant controlling effect on speed limits established along various rail lines. Our recommendations regarding the priority implementation of this technology in the Greater Toronto Area should be seen not only for its overall enhancement to public safety, but as a positive contribution to this speed question as well.

4.8 Research and Development Priorities

4.8.A General

Research and Development strikes at the very heart of efforts to improve rail public safety for the future. Without it the railway system will technologically age; the railway's competitive edge will erode; revenues will decline; and safety will diminish. With Research and Development, on the other hand, continued efforts towards improved safety and productivity can be realized. The existing railway system in the Greater Toronto Area, although safe in relative terms, would benefit from continuous and vigorously promoted safety Research and Development.

The term 'research' constitutes an umbrella for numerous activities. Those in which we are most interested relate to finding the reasons for rail system failures and their remedies, and safer ways of transporting and containing the rail flow of dangerous goods in densely populated urban areas.

This inevitably encompasses activities aimed at determining more economic and productive ways of accomplishing tasks. In reality, economic and productive objectives frequently have a safety component, and vice-versa.

To be productive, and presumably more competitive, it is necessary to operate a rail system safely and reliably. Accidents cost the railways through lost production, in-transit delays and damage claims.

As mentioned earlier, during our visit to the Port Terminal Railway in Houston we were impressed by the Safety, Efficiency and Economic philosophy of its General Manager and the results this philosophy has achieved. In the period 1980 to 1986, this Safety First philosophy achieved the following claims and cost reductions while also achieving a productivity increase of 22%.

Port Terminal Railway (Houston)
(Claims and Costs)

	1980	1986
Reportable Injuries	187	11
Lost Work Days	3,127	349
Claim Payments	$600,000	$8,000
Crossing Accidents	38	9
Derailments	209	128
Human Error Derailment	57	44

While we are not suggesting that this improvement came about solely because of an emphasis on Safety, and while we acknowledge the substantial differences in size and complexity of this operation compared to that of Canadian Pacific and Canadian National, this success story reinforces our own strongly held views that an effective Research and Development program is vitally important in the pursuit of enhanced public safety.

4.8.B Under-utilization of Research Facilities

At all the rail research establishments we visited, we were impressed with the capability and sincerity of those with whom we met and with the achievments of each in their past endeavors. But we were surprised and distressed to see the low degree of utilization of expensive research and testing equipment and facilities.

We visited the Association of American Railroads' Transportation Test Centre in Pueblo, Colorado and the Transportation Systems Centre in Cambridge, Massachusetts. The latter depends largely on annual budget allocations of various US departments of government; the former on Federal Railway Administration and supplier/carrier sponsored projects.

In Canada, both the National Research Council's transportation laboratory and the Transportation Development Centre's budgets depend on the Government's annual allocations. Funds for rail research at the Transportation Development Centre, in Montreal, were scheduled to decline, as its rail program draws to a close. Even though this Centre undertakes projects for industry and the Provinces as well, we were concerned to learn that its Rail Program appeared to be in a period of uncertainty, just when the Government was stressing rail safety.

Researchers at the Transportation Test Centre in Pueblo, Colorado, expressed genuine frustration. While research people would always like to do more than funding allows, we noted a real desire to advance and to pursue areas that would improve public safety, but conditions did not seem to allow this. We noted the same frustration in Canada, particularly with the National Research Council experts. At this institution, there existed excellent testing and research facilities but inadequate staff to carry out projects.

While trying to make our way through the 'maze' that seems to exist in the Research and Development area of rail safety, the Task Force felt these same frustrations.

Research and Development personnel were quite open and candid with us in discussing the overall lack of Research and Development co-ordination. As an illustration of this point, one official, when pressed by the Task Force to offer an opinion on the adequacy of Research and Development funding, stated that he was not really sure if increased funding was actually needed or not. In fact, he was of the opinion there could possibly be adequate funding now. What was needed, he felt, was a determined effort on behalf of governments and industry to co-ordinate the projects now being carried out and then to determine the funding, and the agreed-priority base, necessary for them to proceed. We found this attitude most refreshing.

Another area of concern is the precarious future of railway laboratory and field Research and Development on an ongoing basis. Take, for example, the ongoing funding for the Association of American Railroads' Transportation Test Centre, in Pueblo, Colorado. The Association now operates this Test Centre with funds from the US Federal Railway Administration, from its own membership contributions, and from individual railway company projects.

The Association's own funding is allocated through a vote taken on a year-to-year basis by the Association's Board of Directors, made up of various railroad companies. With deregulation in the U.S.A. (and starting in Canada) and with competition becoming more intense, some of the Association's members may be reluctant to put funds into Research and Development which could benefit their competitors. (This same attitude does not appear to exist in Canada at this time.) However, as the Canadian railways are only a part of the Association of American Railroads, this situation should be watched carefully.

If the Transportation Test Centre is allowed to shut down, the Canadian railway system would lose a valuable resource in the entire area of Research and Development. While Canadian National and Canadian Pacific both have their own Research and Development capabilities, the loss of the Transportation Test Centre would be most detrimental to Canadian Research and Development programs generally, and to railway public safety specifically.

4.8.C Lack of Research Coordination

Added to our concerns regarding Research and Development is the fact that neither the Transportation Development Centre in Montreal, the National Research Council in Ottawa, nor the Transportation System Centre in the U S A, have any direct link with the analysis of rail accident causes.

They have been brought into the review of accidents from time to time, but this has been on a project-by-project basis. It appears, unfortunately, that research activities are to a great extent crisis driven.

As an illustration of this point, we enquired about a Railway Transport Committee recommendation involving the need for Research and Development in a specific safety related area to prevent further accidents and were surprised to learn that the Transportation Development Centre in Montreal was completely unaware of this recommendation — even though it had been directed towards the Centre. While the Railway Transport Committee and Transportation Development Centre link was at one time more direct, this link has become extremely blurred over the last number of years.

Research and test work being undertaken by the Association of American Railroads, Canadian National, Canadian Pacific, and many of the major U.S. railroads is both active and objective-oriented. One of the most significant projects undertaken by industry is the Advanced Train Control System. This was initiated by Canadian Pacific, Canadian National and the Railway Association of Canada, and is now managed as a North American railway project under the auspices of the Association of American Railroads. Wherever we went in Canada or in the USA, we were told of this Canadian initiative. Canadian Pacific and Canadian National should be congratulated for starting this project.

Railway laboratories, including the Association of American Railroads' laboratories, have the added function of undertaking supplier acceptance and qualification testing. These activities are important to the ongoing needs of the railways so that they can be sure of conforming with government regulations. The railways and the Association of American Railroads also undertake product improvement research for suppliers, such as research into performance characteristics of track and vehicle systems, aimed at performance and maintenance improvements. This research, of course, also includes safety and productivity objectives. The National Research Council, the Transportation Development Centre and the U.S. Transportation System Centre do not undertake this type of supplier testing.

While technical co-ordination is possible between government agencies in Canada and the US, this is largely an informal arrangement based upon a Memorandum of Understanding between Canada's Minister of Transport and the USA Secretary for Transportation. Under this arrangement, joint research project agreements have been negotiated and carried out, but at the time of our enquiries funding levels had declined and no international projects were in effect.

The railways in North America are technically very similar, and face essentially the same problems. Tank cars are interchanged between US and Canadian railways on a daily basis. A closer degree of cooperation concerning research and safety, formally established between the two governments, would enhance the pursuit of improved railway safety.

A severe lack of co-ordination exists in this field. This makes it impossible to determine if adequate funds are available to carry out proper research in the field of railway safety. Such research co-ordination could be the means of prioritizing and adequately funding an ongoing railway safety research program utilizing the facilities of both countries, as appropriate.

The structuring of any resulting program is, we feel, important to its success. The presence of a prominent carrier or supplier should be required in any program co-ordination to include program design and management by those who possess the most up-to-date technical and operational knowledge. The government's role should be primarily one of leading, monitoring and facilitating. Funding should imply a commitment by both parties and should be proportioned in relation to the economic and safety content of the projects involved.

With economic deregulation accomplished in the US and launched in Canada, emphasis on a co-ordinated railway safety research program will serve to complement the emphasis on productivity that market competition will generate, while ensuring ongoing Research and Development in the case of Public Safety.

We therefore urge and recommend, in the strongest terms possible, that:

- **The Minister of Transport undertake to co-ordinate the railway safety research program in Canada and from this co-ordination determine and address the priority of projects, the funding and the facility requirements necessary to ensure its effectiveness; and that**
- **Since it is acknowledged that the rail system is a North American operation, the Minister of Transport, in conjunction with his/her United States counterpart, undertake to co-ordinate the railway safety research program in North America.**

Little will be achieved in the area of improved railway safety if the results of the railway safety research program are not implemented.

We therefore further urge and recommend that:

- **The Minister of Transport ensure that railway safety research objectives are met on a constant and continuous basis, through the implementation of meaningful projects.**

4.8.D Priority Research Projects

Throughout our Report we have mentioned the need for research on several occasions; we felt a summary of all these points would be useful. The following safety research projects should be initiated, accelerated and/or vigorously promoted:

- **Advanced Train Control System (ATCS):**- to ensure the accurate, timely and necessary control of train operations including information requirements to the train engineer;
- **The Human/Technology Interface:**- to assist in improving the human component of the railway system and the ergonomic requirements of this important part of the railway system;
- **Speed:**- the effects of speed on the cause of accidents and on the severity of accidents;
- **Concrete Ties and Direct Fixation Fasteners:**- to ameliorate the effects of harmonic oscillation and to improve track stability. Direct fixation and hardwood ties could also be explored in this regard;
- **Brake and Load Adjustment Devices:**- to assist in reducing dynamic in-train forces;
- **Train Marshalling and Positioning of Dangerous Goods Cars:**- to ensure the safest positioning of these cars within a train (incorporating work being done in Great Britain), and to determine the optimum distribution of loaded cars for safety;
- **Wheel Climb:**- to reduce wheel climb at low speeds;
- **The Failure Rate of Roller Bearings:**- to determine why and how roller bearings fail and to develop counter measures, both in terms of monitoring and in terms of prevention;
- **The Three Piece Truck:**- to assist in reducing hunting phenomena which predominantly occurs at higher speeds;
- **Weld and Tank Shell Metallurgy:**- to assist in determining and improving the integrity of new and repaired tank cars; and finally
- **Tank Car Integrity and Design Improvements:**- t oincrease the containment integrity of tank cars both in normal use and in the case of accidents.

Many of the above are already receiving attention but need to be accelerated. One notable exception, as previously mentioned, was the human factor issue; until recently it was not an area being actively pursued. We were, to repeat and to say the least, most surprised to learn of this and again urge that an emphasis be placed on this subject. While we acknowledge that these concerns have been mentioned previously, we feel strongly that rectifying steps are needed in this area and therefore we want to stress this point.

We therefore recommend that:

- **The many safety Research and Development opportunities identified by the Task Force, especially those dealing with the Human Factor, be structured into a co-ordinated and adequately funded program; and that**
- **It be recognized that safety Research and Development is of vital importance to the ongoing enhancement of public safety, especially those projects affecting the rail flow of dangerous goods in densely populated urban areas.**

4.9 Emergency Preparedness and Response

4.9.A General

Even with the most determined efforts to improve safety, accidents will always be a possibility and the community must be prepared to respond.

We were asked by Regional and Municipal governments and many individuals to examine the issue of emergency response. We commissioned consultants to investigate this issue. We heard from several 'first responders' (the railways, industry, police and fire personnel) about their experience and suggestions for improvement. The Regional Police who handled the 1979 Mississauga derailment were particularly helpful, providing us with their debriefing notes and their video presentation on the steps that had been taken or should have been taken.

We visited San Antonio, Texas, the site of another major derailment, and talked with the Fire Department and Municipal officials of that City. We learned how the derailment in Livingston, Louisiana and in Orillia, Ontario were handled; how emergency response, in general, was being carried out in Great Britain and the USA; and we heard from the chemical and petroleum industries in this regard. Finally, we toured the Greater Toronto Area to appraise the evacuation and response requirements which would be encountered if a major derailment, involving a dangerous goods spill, were to occur.

Our public perception survey indicated that a large segment of the general population in Greater Toronto does not think such an accident is inevitable. Yet there is a strong desire to be assured that emergency planning and preparations are in place, and to be informed on what to do in the case of an emergency.

Our consultants compiled a comprehensive and thorough review of emergency preparedness in the Greater Toronto Area. We were impressed with the depth and detail of this review and suggest that their report (appended as a separate supporting volume) be read. They conducted interviews with more than 50 personnel from fire and police departments, emergency planners, ambulance services, government officials, hospitals, industrial and private response units and the railways. They reviewed 35 Municipal emergency response plans. And they examined the legislation in place governing these emergencies.

Some of their conclusions may be challenged; this is to be expected. Even so, it is easy to see from their report why Municipal representatives are so concerned.

Emergency preparedness in smaller municipalities does not appear to be a high priority. Many of these communities are unaware of the risks inherent in the rail and truck flow of dangerous goods. Many depend on volunteers to respond to fires, and emergency response plans are either non-existent, inadequate, or woefully out of date. In stark contrast, a number of the larger Municipalities have recently undertaken emergency simulations; have up-to-date plans which are relevant and fairly comprehensive; have modern facilities and equipment; and have well trained and experienced personnel.

We learned that the chemical, petroleum and railway industries were well prepared, trained, and equipped to handle emergencies. During Canadian National's presentation to us on the subject, we learned about their organizational structure and the roles various functions perform in an emergency. We visited their operations room and saw first hand the availability of computerized operational data and the comprehensive set of procedures that would swing into action, if needed.

4.9.B Emergency Response Concerns, Observations and Recommendations

Although we were impressed with some aspects of the emergency preparedness and response capabilities of some Municipalities in the Greater Toronto Area, we were surprised and disappointed to learn of the deficiencies and inconsistencies that existed. Because of these, and because there does not seem to be any significant pressure for Municipalities to adopt emergency plans or to acquire adequate response capability, the Task Force wishes to describe some of the deficiences highlighted to us by our consultants and offer some suggestions for improvement.

Lack of Adequate and Co-ordinated Emergency Plans

It had been our impression that one of the responsibilities of the Regional tier of government was to ensure effective emergency co-ordination and response in the various situations which may arise - including dangerous goods accidents. Yet our review indicated that this co-ordination between Municipalities and the Region, and between the Municipalities themselves, was not always in evidence.

Inconsistencies exist even between those plans that are in place, making it difficult to co-ordinate and implement mutual aid. While most of the plans in place described, in general terms, the roles of various groups, the lack of precision as to their duties, and the lack of their identified authority greatly diminished the effectiveness of this planning exercise.

While co-ordinated planning is only one aspect of emergency preparedness, we believe that it is a necessary and important function. Without plans, properly practiced through simulations and fine-tuned through experience and information sharing, the unpredicable events posed by an accident will only be all the more overwhelming.

We recommend therefore that:

- **Emergency Response Plans properly co-ordinated and consistent between the Municipalities and the Regions in the Greater Toronto Area be made mandatory; and that**
- **These plans identify specific requirements to respond to railway dangerous goods accidents.**

Inadequate Communications and the Need for a Single Spokesperson

Along with good planning goes the need for direct, authoritative, and decisive communications. What impressed us most with the San Antonio, Texas emergency response was the presence of clear and direct communications which instilled, in the general public, a sense of confidence that the situation was being managed properly.

In the case of Mississauga, it was obvious to us that Mayor Hazel McCallion's active role, on behalf of the Municipality, went a long way to allay public fears and anxiety. It may also have been the reason, our consultants advised us, that our public perception survey showed that Peel Region residents appeared to have less concern about dangerous goods moving through their area than did persons residing in other Regions. We found that the levels of public anxiety increased significantly with their lack of knowledge of the situation.

This was pointedly brought home to us during the minor derailment in Orillia, Ontario. In that accident, too many spokespersons existed; mis-interpretations were generated and reported by the media; unnecessary and undue anxiety was created amongst the affected population.

In some cases (especially in a significant emergency), up to fifteen different departments, agencies and industrial entities can get involved - all operating within their own legislated authority and all attempting to be helpful and responsive. The outcome has usually resulted in confusion. It is imperative that emergency response roles be properly defined, and the concept of a single spokesperson, closely associated with the technical emergency response operation (so that accurate information can be disseminated), be accepted.

We recommend therefore that:

- **Accurate and timely communications be recognized as a vital component in responding to an emergency and be incorporated in the mandatory plans; and that**
- **Emergency Response communications be improved through properly-defined roles/jurisdictions of the responders and through the use of one spokesperson communicating with the public.**

Our review of the various levels of emergency response command in place within the railways indicated that a great deal of thought and planning had been devoted to this area. The railways are however primarily organized to respond and to cope with accidents and events which occur in and remain within their rights-of-way. Once an emergency has expanded beyond the right-of-way, roles became more blurred.

We further recommend therefore that:

- **Emergency Plans pertaining to the rail flow of dangerous goods in the Greater Toronto Area have input from the two major railways and the chemical/petroleum industries involved.**

Lack of Training and Equipment

While there are a number of emergency response courses dealing with dangerous goods, only a few volunteer first responders have taken these courses. This point was also stated by the U.S. Office of Technology Assessment in its July 1986 report to the US Congress, which reported that 85% of all the training dollars were expended on the 20% of US fire personnel who were permanently hired; the other 80% of fire department staff were volunteers and inadequately trained.

Our consultants advise us that while industry and the large communities appear to have adequate equipment, training and personnel, the smaller communities appeared to be lacking in all three areas.

All communities must be prepared to handle the emergencies they may encounter. Our consultants determined the amount of equipment and supplies, training, personnel, public awareness and education resources that would be necessary to upgrade those Municipalities presently below a minimum standard. They developed three sets of minimum standards depending on the size and complexity of a Municipality. A total one-time expenditure ranging between $2.5 - $4.3 million would appear reasonable to bring all Municipalities up to standard. They also examined the emergency response needs by Municipality and by Region, sorting these costs by the rerouting alternatives the Task Force studied. These costs are shown in Exhibit 4.15.

Lack of Public Awareness

We were surprised at the lack of awareness by ratepayer and community groups about where they should go to get the basic kind of knowledge they would need in an emergency. Responses to Task Force's queries, during our Public Hearings and during our public consultation programs, indicated the public appreciated obtaining the kind and amount of information we were providing. At the same time there was a strong indication that they were quite unaware of what was occurring in their neighbourhoods or where they could go to get this data.

The constant demand from the public to be assured that "all that can be done, is being done" is nowhere more pertinent than it is in this area of emergency response. It is our view that the public have respect for, and confidence in their emergency response personnel and facilities, but that they are also quite unaware of the deficiencies which exist.

We conclude that good emergency response requires a well informed public capable of reacting in positive and decisive ways.

It is for this reason that we recommend that:

- **Emergency Plans, and simulation exercises, include a Public Awareness and Education component through the issuance of information brochures, pamphlets and pertinent emergency response data.**

Lack of Emergency Response Access to Rail lines

The Town of Vaughan's Fire Chief told us that access to rail lines through residential developments in his jurisdiction was extremely difficult. With the use of slides and maps, he indicated that housing was built so close together that he was not able to get his response vehicles between them. Hoses and response equipment would have to be hand carried into backyards, up berms with steep slopes, and over eight foot walls. Even after this exercise, the water supply would be inadequate to cope with a major rail disaster .

We toured several developments in the Greater Toronto Area and saw similar examples of restricted access to rail lines. Our consultants also found that access to rail lines is a problem, and would be next to impossible to rectify. They suggested that access should be a requirement on any newly constructed line, and we agree.

We recognize that there is a potential conflict between ease of access for emergency response and the potential for unsafe trespass by the general public onto railway property.

We nevertheless recommend that:

- **All Levels of Government, but particularly the Provincial and Municipal Governments, and the railway industry ensure full and adequate access to all parts of a railway line**

Exhibit 4.15
Approximate Costs to Upgrade Emergency Preparedness Along Existing CN/CP East-West Routes and along Proposed Corridors

Existing System
Resources/Training Costs

Burlington	$125,000
Milton	$125,000
Halton Hills	$150,000
Brampton	$15,000
Mississauga	$15,000
Etobicoke	$15,000
Toronto	$15,000
East York	$125,000
Vaughan	$125,000
Markham	$15,000
Scarborough	$125,000
Pickering	$125,000
Ajax	$125,000
Whitby	$15,000
Oshawa	$15,000
Sub Total	**$1,130,000**
Region of Halton	$210,000
Region of Peel	$210,000
Region of York	$210,000
Region of Durham	$210,000
Sub Total	**$840,000**
Resources Total	**$1,970,000**
Public Awareness and Education Costs	**$650,000 to $2,300,000**
Total: Resources and Education	**$2,620,000 to $4,270,000**

Estimated costs have been calculated for the main east-west existing and proposed corridors.
A large number of spur lines run north-south from the main line carrying relative small volumes of dangerous goods. Basically, the same spur lines would be used for the existing and proposed routes and they therefore would not be a factor in distinguishing cost differences between the options. Thus, the added costs are not accounted for in the table.

Corridor B
Resources/Training Costs

Burlington	$125,000
Milton	$125,000
Halton Hills	$150,000
Caledon	$150,000
Vaughan	$125,000
Markham	$125,000
Scarborough	$15,000
Pickering	$125,000
Ajax	$125,000
Whitby	$125,000
Oshawa	$15,000
Sub Total	**$1,205,000**
Region of Halton	$210,000
Region of Peel	$210,000
Region of York	$210,000
Region of Durham	$210,000
Sub Total	**$840,000**
Resources Total	**$2,045,000**
Public Awareness and Education Cost	**$490,000 to $1,700,000**
Total: Resources and Education	**$2,535,000 to $3,745,000**

Corridor C
Resources/Training Costs

Burlington	$125,000
Milton	$125,000
Halton Hills	$150,000
Caledon	$150,000
King	$150,000
Aurora	$125,000
Whitchurch-Stouffville	$150,000
Uxbridge	$150,000
Scugog	$150,000
Newcastle	$125,000
Sub Total	**$1,400,000**
Region of Halton	$210,000
Region of Peel	$210,000
Region of York	$210,000
Region of Durham	$210,000
Sub Total	**$840,000**
Resources Total	**$2,240,000**
Public Awareness and Education Costs	**$450,000 to $1,550,000**
Total: Resources and Education	**$2,690,000 to $3,790,000**

carrying dangerous goods in a densely populated urban area without encouraging unsafe trespass; and that

- **Provincial and Municipal planning guidelines and practices ensure that adequate and sufficient emergency response requirements are addressed to cope with dangerous goods rail accidents in those areas where rail lines are located.**

Lack of Consistency in Railway Emergency Response vis-a-vis Municipalities

Both railways have excellent emergency response capabilities and organizations. Emergency response telephone numbers are fully distributed to all first responders in the Greater Toronto Area and specialized, well trained staff occupy Operation Rooms on a 24 hour basis.

However there are some inconsistencies between the operations of the two railways, such as the way the consist listing is prepared. It is not our intention to pass judgement on how these inconsistencies should be resolved; but in the case of emergency response and in the case where public safety is involved, every effort should be undertaken to remove all obstacles to a quick and rapid emergency response. All ambiguities and areas for misinterpretation should be resolved.

We recommend therefore that:

- **The railways standardize all their operations as it affects emergency response (i.e. consist documentation; emergency procedures; response team duties and responsibilities);**
- **The railways notify all first responder agencies in the Greater Toronto Area of these standard practices and procedures; and that**
- **The railways participate, with the Greater Toronto Area first responders, in simulation exercises, especially involving the rail flow of dangerous goods.**

Evacuation Difficulties

Our consultants advised us that some communities have focused their entire emergency planning on a strategy of evacuation, but have not given enough thought to the resources and the organization needed to carry it out.

They also outlined the magnitude of a dangerous goods evacuation. We know the experience of the Mississauga

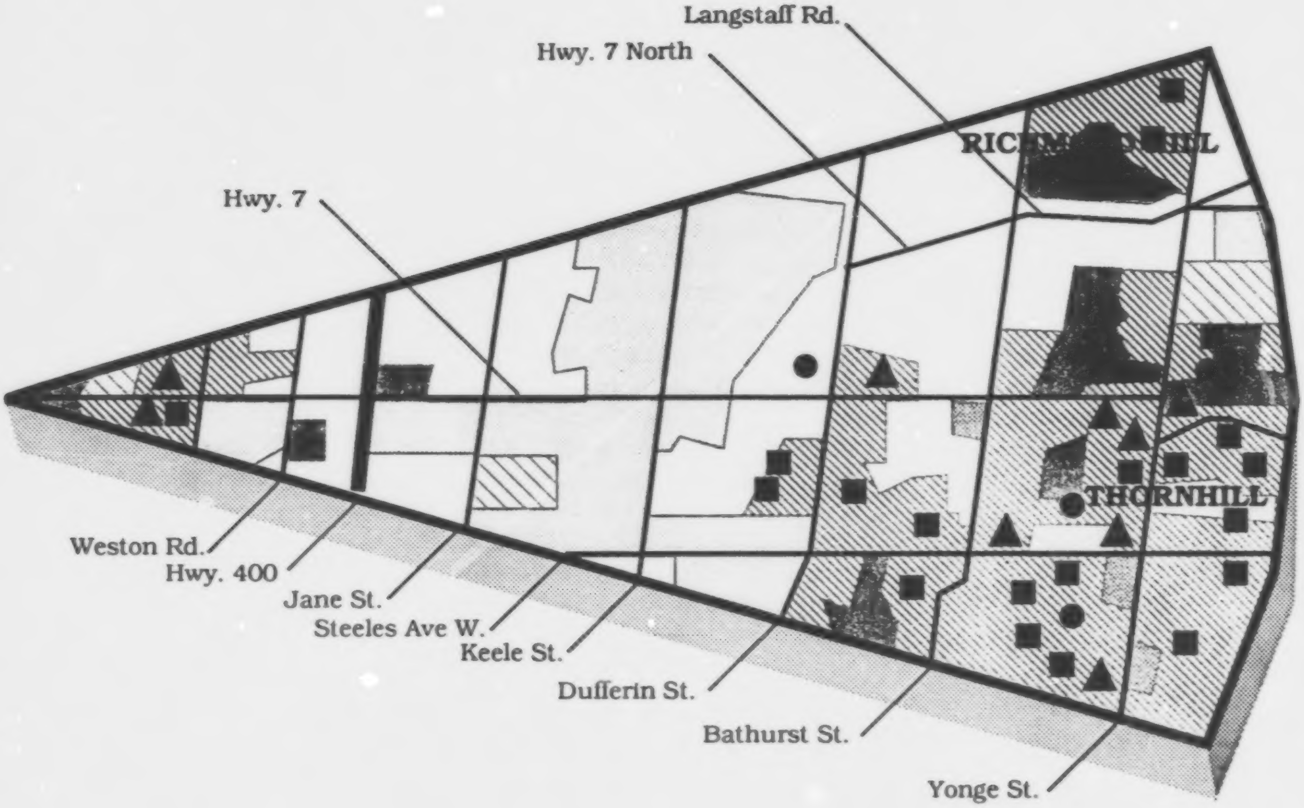

Langstaff Rd.
Hwy. 7 North
Hwy. 7
RICHMOND HILL
THORNHILL
Weston Rd.
Hwy. 400
Jane St.
Steeles Ave W.
Keele St.
Dufferin St.
Bathurst St.
Yonge St.

Exhibit 4.16
Woodbridge
15km Impact Zone
30⁰ Plume from WSW

Commercial	▒	▓	Parkland
Industrial	☐	▨	Residential
Open Space	☐	▨	Cemetery

■ School ▲ Church ● Community Facility
(i.e. arena, pool)

evacuation. We know the experience of the Mississauga evacuation of nearly a quarter of a million persons. Our consultants developed further, theoretical impact zones postulating the effects of a 15 kilometre chlorine plume occurring at various locations in the Greater Toronto Area.

An example of such a plume is shown in Exhibit 4.16 for an accident in the Woodbridge area, just north-west of the City of Toronto. If such an accident were to occur in the Bloor-Islington/Kipling area, or along the Canadian Pacific's consultants expect that several major hospitals would have to be evacuated, thus reducing or eliminating some major emergency response facilities when they are needed the most.

During our tours of the Greater Toronto Area we witnessed the narrow and winding roadway systems - especially in the older parts of the cities. We saw schools, hospitals and senior citizens establishments located next to railway lines. We learned of the difficulties involved in first informing, then moving large numbers of people in a relatively short period of time.

The British Health and Safety Executive advised us that evacuation should not always be considered a viable alternative. They stressed that occasions may exist when it is safer to stay indoors and to close all doors and windows. This question, we believe, requires further clarification since in the Greater Toronto Area we continually heard of the need to address a full evacuation.

In discussions with such cities as San Antonio and Houston, Texas, we learned that many United States jurisdictions are concentrating resources on improving emergency response capabilities. Other countries are taking similar courses of action.

Evacuation in some locations of the Greater Toronto Area could only be undertaken with great difficulty. Successful evacuation can best be achieved through a fully informed and co-operative populace, guided and assisted by well trained and knowledgable emergency response units. The recommendations previously made with regards to public information, emergency response capability and simulation exercises apply here as well.

Railway Demand on Emergency Capabilities

In his presentation to the Task Force, the Fire Chief of Vaughan indicated that his department responded to over 1300 calls at Canadian National's McMillan Yard in 1987. The majority of these calls were minor in nature, for such matters as grass fires, tank car leaks, and 'standing-by' during the transfer of dangerous goods. Regardless of the nature of the call, the demand was there and Vaughan's Fire Department responded.

The railways pay taxes like any other business enterprise, and these taxes go towards paying for fire protection. However, excessive demands may require some extra compensation. While the railways have developed an excellent response capability, the dangerous products they handle may exceed that capability and may effect others outside their property and rights-of-way. We are of the opinion therefore, that the railways, as a normal cost of doing business, should hold discussions and agree to compensate the Municipalilities in which they have railway yards, to cover the emergency response costs over and above that which could be considered a reasonable average.

We recommend therefore that:

- **The railways and Municipalities in which rail infrastructure (primarily rail yards) exists, mutually agree as to an adequate provision of emergency response and an appropriate sharing of costs.**

We will discuss the cost apportionment of these emergency response recommendations shortly.

4.10 Costs and Who Pays

4.10.A General

What we are recommending for the shorter term improvements costs money - particularly for accelerated work. As with the longer term routing alternatives, we reviewed the spectrum of those who would receive benefits from these more immediate improvements, and who may be expected to bear the costs of upgrading. As with the longer term alternatives, we also determined that all the interested parties - the Federal, Provincial and Municipal Governments plus the railways and the general public would benefit.

4.10.B Cost Apportionment

Operating and Capital Costs

In the case of operating and physical railway system upgrading required for short term improvements, if the railways, within their competitive business environment, are expected to implement these in their normal course of maintenance and plant upgrading, then they should be required to pay for these improvements. If however it is felt that higher levels of public safety are required over and above those that could be reasonably expected from an already relatively safe operation, or if it is felt that the improvements we have identified should be implemented at an accelerated rate, it is our opinion that these costs should be borne or at least shared by those requesting the acceleration or the higher level of safety. Since in the final analysis it is the Federal Government which will dictate requirements to the railways, it is our opinion that it should be the Federal Government which should ultimately bear the additional cost burden.

There are some cases however where the railways on their own have made provisions in infrastructure, equipment or operations in excess of those mandated by regulation or in excess of company standards. In some instances, these provisions have been made with public safety in mind; but other reasons, such as reducing track occupancy by maintenance forces or reducing operating costs, are also valid. In all circumstances where these actions have been taken in the past by the railways, they have borne the full cost.

Where the underlying reason is one of operating convenience, or economy, the railways should continue to pay for upgrading facilities. However, the railways also have the obligation to operate in a safe manner. In special circumstances, such as in locations where the right-of-way is confined or where special dangerous commodities are transported there is a clear obligation to take added precautions. We believe that this obligation should continue to be the general responsibility of the railways.

In cases where the Minister of Transport considers that adequate precautions are not being taken, the railways may be ordered by regulation to comply with certain stipulated requirements. (The process for rulemaking will, we understand, be interactive between the Minister and those affected by the proposed rule, thus enabling the economics as well as the safety impacts to be evaluated. The Minister's decision to implement a proposed rule will therefore consider the public good as well as the economic impacts). Complying with such a decision will, of course, be the obligation of the railways, at their cost unless otherwise stipulated.

Where special provisions however, are ordered by the Minister of Transport to be taken by the railways for application to a specific locality or circumstance, or where these provisions are not applicable on a regulated basis nationwide, we believe that there is a valid case that the cost of such special provisions should be borne by the Federal Government.

Research and Development Costs

In the area of Research and Development, it is the Task Force's strong view that further enhancements to public safety will be achieved primarily through the successes made in this area. While Research and Development can yield impressive gains, and while it takes large cash outlays to carry out the first stages of Research and Development, it may take even larger cash outlays to successfully implement an innovation significantly contributing to public safety. If, for example a redesigned train wheel were developed which would greatly reduce accidents, many thousands of wheels would have to be manufactured and exchanged. We are of the opinion therefore that ways and means need to be sought (such as tax incentives or accelerated write-offs) which would encourage and promote the research, development and implementation of measures to improve the safety of the rail flow of dangerous goods in densely populated areas. This area of tax incentive lies with the Federal Government since benefits achieved in this area would be applied nationally. There is a concern however, that research which is directly 100% government funded can be less relevant to railway system needs and priorities. The funding mechanism initiated must not lead to this situation.

Emergency Response Costs

In the area of Emergency Preparedness and Response, we see this as much more of a local matter affecting the Province of Ontario, the Municipalities and the railways. We have already indicated, in an earlier Emergency Response section, our views regarding the railways and the Municipalities agreeing on an adequate level of service above which extra compensation should be considered. We do not believe it to be in our mandate to determine the cost breakdown between the Province of Ontario and the Municipalities, except to say that any emergency response enhancements to combat dangerous goods accidents on the railways would certainly be employed against other risk areas in the community, particularly when truck movements are considered.

4.10.C Cost Apportionment Recommendations

Given the above, we therefore recommend that:

- **Operational and infrastructural improvements to the railway system should be borne by the Railways if allowed to do so at a reasonable pace and within the normal maintenance and replacement cycles;**
- **The incremental costs of accelerated programs of railway improvements, or of enhanced levels of public safety in the transportation of dangerous goods in densely populated urban areas over and above that which could reasonably be expected to be borne by an already safety complying, competitive business entity, should be borne by the Federal Government;**
- **Incentives and encouragement be given by the Federal Government to the railways and other agencies as a way of promoting safety Research and Development, recognizing**

that any funding mechanism must ensure the conduct of relevant and co-ordinated research;

- **Emergency Preparedness and Response costs to meet the minimum requirements for coping with rail dangerous goods accidents be borne by the Province of Ontario and/or the Municipalities; and that**
- **The railways as a normal cost of doing business, compensate the Municipalities in which rail yards exist for emergency response demands in excess of a mutually-agreed level.**

4.11 Short Term Conclusions

Our investigations, studies and deliberations involving improvements for the existing system have concluded that opportunities do exist to enhance public safety.

In summary, we have concluded that:

- The rail system for the transportation of dangerous goods in the Greater Toronto Area is relatively safe but, through the introduction of operational, technological, and human factor improvements and the implementation of safety Research and Development projects, could be made safer.
- The achievement of safety should consider the interactive elements of the total system including car load, car placement, equipment, track and operating environment, and the human element.
- Human factors have to a very large extent not been considered as a necessary component of the railway system design even though this runs counter to the fact that the human is, and always will be, an important component in the operation of the system.
- System Safety Analysis is a recognized professional technique which should be assessed and, if proved beneficial, should be employed on railways systems similar to advanced-technology transit systems.
- A Track Classification System be established for the railways which would encompass their total operation (from subgrade through to the operational side) and against which inspection and monitoring results could be measured.

- In order to enhance public safety in densely populated urban areas such as the Greater Toronto Area, track on which trains carry special dangerous commodities should be maintained to a higher standard than is required by the Track Classification System. We have labelled this, the 'DG Level'.

- The design, construction and maintenance of tank cars, at facilities specializing in this area and certified by the Association of American Railroads, is being responsibly undertaken. We believe however, that input by the Regulator into the design and certification process would be beneficial.
- Tank car repairs not undertaken at facilities specializing in the design and manufacture of these vehicles are a cause for concern, even though these facilities may be certifed by the Association of American Railroads. (This concern is supported by the Association's Tank Car Committee as well).

- The principle of providing an increased margin of safety is recognized in tank car design for certain special dangerous commodities and thereby a degree of indestructibility is being obtained. We do not consider full indestructability to be an economic proposition nor one which would achieve a higher degree of total transportation system safety if applied to railways alone.

- In view of the sensitive nature of special dangerous commodities, the railways must pay an extraordinary attention to the handling of these commodities over and above regulated requirements.

- Roller bearings can fail between monitoring stations at 20 mile separations. The spacing of monitoring devices should be reduced in areas of high population density.

- The order in which cars are marshalled with respect to weight and location of dangerous commodity cars and also with respect to the length of trains are factors which affect safety and should be reexamined.

- No conclusive evidence was uncovered to warrant recommending changes to regulations governing railway speeds.

- Cars in a train are not listed on the consist in the same manner by both railways. This can lead to confusion for the 'first responders' at an accident scene.

- Consist listings are only carried at one end of a train. Duplicate consist listings, one located at each end of the train, would be helpful to some 'first responders' at the scene of an accident. Several operational problems were however acknowledged. These should first be overcome.

- Research appears to be crisis driven. It should be regarded as a continuous process for which the potential to achieve safety and economic advances can be significant.

- Research into the causes of accidents and the solutions achieved therefrom should be encouraged. Some of these can be implemented in the very short term, others such as the development and installation of the Advanced Train Control System Level 30 will take time. (ATCS Level 40, if such is required, will take much longer). Implementation of these measures will, we believe, provide a great deal of benefit as far as improving safety is concerned and will also reassure the public concerning safety.

- Research Laboratory facilities at the National Research Council, and elsewhere, are not fully utilized in the pursuit of railway safety improvement research and development.

- Canadian and US government research programs with safety improvement objectives are subject to short term funding commitments. Due to the lack of research coordination, we were unable to determine if research funding levels were adequate.

- Costs incurred in implementing safety improvements can be significantly greater than the costs of their development. If not economically justified, these improvements can be postponed. Favourable treatment of these initiatives, in the economic sense would be a worthwhile initiative.

5.0 Summary and Recommendations

5.0 Summary of Recommendations

The following is a summation of our Recommendations sorted by topic. The number in the brackets at the end of each Recommendation represents the page in the Report at which the supporting discussion and the original Recommendation can be found.

5.1 Public Safety

Who manages Safety in Canada

- The Minister of Transport, as the National Transportation Safety Manager, be fully committed to ensuring the safe operation of Canada's rail system and that this commitment be publicly seen. (2.5)
- Safety be assigned top priority in the transportation of dangerous commodities and that the promotion of safety be publicly tangible, visible and paramount. (2.6)

The Need for National Safety Targets

- National Safety Targets, developed in conjunction with the railways, and expressed in percentage terms (i.e., reduce rail accidents by X% a year), be established, promoted and monitored by the Minister of Transport and that an accounting of the progress made towards this objective be given to the public from time to time. (2.6)
- The Minister of Transport, in establishing these safety objectives, place before the public the Canadian Railway safety record compared with that of other jurisdictions and modes of transportation, so that an accurate and fair judging can be made. (2.6)

Separation of Regulatory Functions

- The legislation required to complete the separation of regulatory, safety inspection and accident investigationfunctions concerning the railways be given utmost priority. (2.8)

The Need for a Centralized,
Multi-Modal Dangerous Goods Data Base

- A comprehensive, ongoing review of dangerous products designation and classification be undertaken. (2.9)

- Transport Canada's Dangerous Goods Directorate be the only agency charged with compiling and promulgating the master classification listing (including special commodity designations) of all dangerous goods offered for transport. (2.9)
- Transport Canada's Dangerous Goods Directorate be given sole responsibility to establish accident and incident reporting criteria in conjunction with the user agencies. (2.9)
- A centralized data base on the transportation of dangerous goods containing similar data elements between Canada and the United States, and maintained by each country's respective Regulator, with accessibility rights of others, be established. (2.10)

A Joint Canada/U.S.A. Commission to Establish Common Cross Border Standards

- A joint Canada/U.S.A. Rail Commission be established to ensure the formal communication necessary to facilitate uniform safety standards governing the cross-border flow of rail cars between Canada and the U.S.A. and that this Joint Commission be mandated to work to improving the standards, thus improving safety. (2.11)
- Representation on this Commission be made up of five persons - one each representing the Canadian and U.S.A. Regulators; one each representing the American railroads (AAR) and the Canadian railways (RAC); and one neutral chairperson. (2.11)

Establishment of a Permanent Advisory Council on the Rail Transportation of Dangerous Goods

- An Advisory Council, reporting to the Minister of Transport on the Rail Transportation of Dangerous Goods be made permanent and be so constituted in its membership as to fully represent all interested parties, including, to a significant degree, the general public. (2.12)
- The Advisory Council on the Rail Transportation of Dangerous Goods be required to work closely with the Consultative Committee proposed in the new Railway Safety Act (Bill C105). (2.13)

Co-ordinated Regulatory Research and Development

- The Regulator have the capability of understanding, using, co-ordinating and, where necessary, undertaking Safety Research and Development as an aid to the promotion of public safety. (2.15)

The Need for an Independent Safety Audit Function

- An Independent Operational Safety Audit function be established with a broad mandate for safety of transportation involving the rail system, the findings of which must be open to full public scrutiny. (2.16)

- The Independent Operational Safety Auditor report directly to the Minister of Transport, in the same way as an internal auditor. (2.16)
- Findings of the Independent Operational Safety Auditor be made available to both the regulatory and accident investigation functions as well as any railway, shipper, receiver or other parties audited for subsequent action. (2.16)
- Steps be taken to ensure that the duties of the Operational Safety Auditor remain, and are seen to remain, separate and distinct from those of the Regulator and that this audit role not be perceived as an encroachment on the regulatory function. (2.16)

Speeding Up Accident Reports

- The federal Regulator ensure that investigations into dangerous goods accidents are initiated promptly; that the 60-day deadline for issuance of the results is met, and that follow-up action on deficiencies or faults shown in the investigator's report is launched without delay. (2.18)

Private Sidings — A Responsibility Gap

- The Railway Safety Act be amended to allow the Regulator to inspect all federally regulated railway cars, especially tank cars, regardless of their status. (2.19)

Communications and Community Interface

- The railways should pay more attention to community information exchange and cooperation in order to provide greater assurance and appoint, as a normal business expense, a co-ordinator who would interface with municipalities and residents' Associations on an ongoing basis. (2.21)
- Regional Municipalities within the Greater Toronto Area individually or collectively appoint a coordinator(s), at a senior level, who would interface with the railways and community groups. (2.21)
- The railways, the Province of Ontario and Municipalities/Regions establish, at a senior level, a formal liaison committee mechanism through which issues can be discussed and resolved. (2.21)
- Governments, at all levels, and the railways promote and encourage an increased level of knowledge and communication within the general public in the area of the transportation of dangerous goods by rail. (2.21)

5.2 The Analysis of Routing Alternatives

Abandonment and Sale of Specific Railway Infrastructure

- No consideration be given at this time to abandoning the present Canadian Pacific Railway's North Toronto Subdivision. (3.29)
- Should rerouting or relocation take place, this right-of-way continue to be used for all 'local' traffic and for 'through' non-dangerous goods freight traffic. (3.29)
- Should excess rail capacities become available on this or any other rail line in the Greater Toronto Area, consideration be first given to their use as possible public transportation corridors. (3.29)

Railway Rationalization (Involving the Parkway Belt)

- A team, consisting of representatives from the Minister of Transport, the Province of Ontario and the two major railways, be immediately established to:
  - ☐ Prepare a plan for the rationalization of the rail systems through the affected area;
  - ☐ Quantify the economic advantages for such a system;
  - ☐ Provide the detailed capacity and operational requirements;
  - ☐ Advise on a type of Joint Use Agency equitable to all parties and suitable for the management of operations in this Joint Use territory; and to
  - ☐ Provide a detailed implementation strategy. (3.66)
- Contingent on rail rationalization, the Parkway Belt Corridor options be considered as providing the best rerouting and relocation opportunity in the Greater Toronto Area. (3.66)
- The specific Parkway Belt option, which diverts dangerous goods into the Belt (thus providing buffering as an increase to public safety for present development), while utilizing the present Canadian National Railways' York Subdivision for general, non-dangerous freight traffic be considered most advantageous. (3.66)
- The Province of Ontario be requested to retain provision for a mainline rail facility in the Parkway Belt in conjunction with its development, planning and constructiuon of other facilities. (3.67)
- In conjunction with the Municipalities, the Rail Rationalization Team be asked to identify, as quickly as possible, those areas along the existing and Parkway Belt segments where additional buffers can be provided through zoning, compatible with rail operations. (3.67)
- The Province of Ontario, in conjunction with the Municipalities, be requested to zone those lands, identified above, accordingly. (3.67)
- The Rail Rationalization Team should also give consideration to the joint use of Canadian National's Kingston Subdivision for the rail movement of dangerous goods in the Regional Municipality of Durham. (3.67)

The North Corridor Options (The 'C' Alternatives)

- As a matter of urgency, the Minister of Transport, along with the Province of Ontario and the railways, undertake a review of the necessary preliminary actions required for determining and developing a transportation/utility corridor in the north of the Greater Toronto Area. (3.68)
- In reviewing the North Corridor, the more southerly North Corridor option (Alternative C-3) be considered the preferred option. (3.68)

Buffers

- The federal government assume the responsibility for establishing buffer zone criteria and that this determination should be done with as much input from the Province of Ontario, the Municipalities, industry and the railways as possible. (3.75)
- The federal, provincial and municipal authorities work cooperatively, in their respective spheres, to introduce or make provision for buffers along new rail lines and rail yards in non-developed areas. (3.75)
- Buffer zones be so established as to allow railway-compatible infrastructure and activity, and that such zones be considered for other transportation and utility corridor uses at the same time. (3.75)
- As redevelopment occurs along existing rail corridors, the Municipalities ensure that compatible land uses are put into place. (3.75)
- As a matter of priority, the federal and provincial governments initiate discussions immediately on how, in the Greater Toronto Area, buffers could apply to the Parkway Belt and North Corridor options and from these discussions develop policy that could be applied here and elsewhere. (3.75)

Costs and Who Pays

- The federal government bear the net cost of any railway rerouting/relocation (after allowing for the benefits that can be achieved with respect to identified railway operating cost reductions; the sale of surplus railway lands; and any identified benefits from a rail service rationalization). (3.78)
- The federal government be responsible for all costs of buffer zone acquisition and for all injurious costs arising from 'compatible use' zoning. (3.78)
- The provincial government and municipalities be responsible for all planning, zoning implementation and administrative activities in this regard. (3.79)

5.3 Improving the Existing System

System Safety Analysis

- System Safety Analysis be assessed by the railways and the Regulator as an approach to improving public safety and that the Greater Toronto Area be considered for a pilot application of this System Safety Analysis technique. (4.9)
- The preliminary failure probability and consequence data base established by the Task Force for the Greater Toronto Area be considered as a starting point for the System Safety Analysis. (4.9)

Level of Safety Classification System

- The railways, in conjunction with the Regulator, implement a classification system consistent with statutory speed restrictions and containing a number of levels, applying to all aspects of their fixed plant and train operations. (4.10)
- This Classification System be made available as public information against which monitoring can be undertaken. (4.10)

Dangerous Goods Classification Level

- Special Dangerous Goods (DG) levels of classification be established for rail infrastructure and operations carried out in densely populated urban areas where the transportation of special dangerous goods is involved. (4.11)
- These Dangerous Goods Classification levels be assigned the highest standards of design, construction, inspection maintenance and operation. (4.11)

Track Quality

- An accelerated program of concrete ties and direct fixation fasteners be undertaken in conjunction with a continuous welded rail program in the densely urban areas of the Greater Toronto Area. (4.16)

Track Inspection

- A significantly increased and more intense inspection effort be undertaken by the railways in the densely populated urban areas of the Greater Toronto Area. (4.12)
- These increased levels of inspection be incorporated as part of the designated Dangerous Goods (DG) Classification levels assigned to this area. (4.12)

Wayside Detectors

- Properly maintained wayside detectors be spaced more frequently than present regulations demand within densely populated urban areas of the Greater Toronto Area. (4.13)
- This reduced spacing be incorporated into the Dangerous Goods (DG) track Classification level established for such areas. (4.13)

Advanced Train Control System

- Advanced Train Control System implementation be given top priority and the full support of all concerned. (4.15)
- The Greater Toronto Area be selected as one of the first locations for the Advanced Train Control System implementation when such technology has been proven. (4.15)

Concrete Ties and Direct Fixation Fasteners

- As a public safety priority, concrete ties and continuous welded rail be installed in the segmentally-identified high risk areas of the Greater Toronto Area first, followed by other locations in this area. (4.16)
- This concrete tie program be the subject of a railway/community discussion since increased noise and vibration may result. (4.16)
- This implementation be subject to an agreed schedule with the Regulator. (4.16)

Installation of Automatic Half Barriers/Grade Separations

- All attempts be made to reduce accidents at rail/road crossings, where only flashing lights and signage now exist, on lines carrying dangerous goods, through an accelerated program of automatic half barriers with train speed sensor activators. (4.17)
- All attempts be made to reduce accidents at rail/road grade crossings, on lines carrying dangerous goods, through an accelerated program of grade separations, where sufficient train/motor vehicle volumes warrant such action and where public safety is of concern. (4.17)
- Public Safety be used as an added criteria in determining the need for grade separations along rail lines carrying dangerous goods in densely populated urban areas. (4.18)
- The federal government re-instate funding for a meaningful grade separation program. (4.18)

Tank Car Maintenance, Modification and Repair

- Effective controls and procedures be implemented by the Regulator to ensure that all repairs on tank cars operating in Canada, and more specifically in densely populated urban areas, be of the highest quality and integrity. (4.25)
- Considering tank car repairs are carried out at shops in both Canada and the U.S.A., this be a subject for the international Joint Railway commission, previously recommended. (4.25)

Tank Car Research and Development

- Research and Development efforts into ways and means of further improving the crash resistance capabilities of tank cars carrying dangerous goods be vigorously pursued. (4.29)

- The Minister of Transport, working in conjunction with the U.S. Regulator, (thereby recognizing the cross-border implications of this effort), provide financial support to the specific area of tank car safety Research and Development. (4.29)

Train Marshalling

- Where practicable (to be defined by the Regulator after consultation with the railways), heavier rail cars be marshalled at the head end of a train. (4.30)
- Research efforts, by the Regulator and by industry, into safe marshalling practices, be emphasized and promoted with vigour. (4.30)

Dangerous Goods Marshalling

- The marshalling and positioning practices and regulations governing Dangerous Goods cars in a train be re-examined.(4.31)
- Until such time as the above re-examination yields a change, the present regulations governing the positioning of Dangerous Goods cars in a train remain fully in force. (4.31)
- The British Rail Marshalling Study, when released, be examined carefully by both the Regulator and the railways for application in Canadian railway operations. (4.31)

Train Length

- Studies be commissioned by the Regulator to determine the effects of the length of a train on its propensity to derail and on the resulting severity of an accident. These studies should be aimed at determining if an optimum, yet practical, train length exists. (4.32)

Train 'Gateway' Inspections

- Gateway, and other train inspection and monitoring procedures and practices, be given priority consideration in their upgrading and effectiveness. (4.33)
- The Gateway boundaries, around the Greater Toronto Area, be more frequently reviewed than is now required and altered, as necessary, to accommodate population growth and development. (4.33)
- For economic and safety reasons, effective automated train monitoring be encouraged and promoted — supplemented, where necessary, by manual inspections and monitoring. (4.33)
- Enhanced, automated monitoring of special dangerous goods trains be encouraged at gateways to ensure that unsafe conditions do not go undetected as they enter populated urban areas. (4.33)

The Make Up of Trains (The Consist)

- The railways agree amongst themselves to a uniform and standard method of producing train consist listings. (4.34)
- The railways seek ways of ensuring that train consist listings carried on trains reflect in as timely and in as accurate a fashion as possible, the true make-up of a train at all times. (4.34)
- Train consist listings, once operational problems have been overcome, be placed at both ends of a train to facilitate emergency response. (4.34)

Residue Cars

- The Regulator, the railways and shippers develop procedures and mechanisms to measure accurately the dangerous goods residue remaining in unloaded pressure tank cars. (4.34)

Leakers

- Current procedures and practices involved in the loading, hauling and unloading of dangerous goods be reviewed including the degree to which all personnel (both shippers and carriers) handling these products are adequately trained, alert, and aware of the consequences of their actions. (4.36)
- Current regulatory requirements be strictly enforced and repetitions of discovered leakage caused by poor handling at loading and unloading stations should bear heavy penalties. (4.36)

Mandatory Rest Periods for Train Crews

- To the maximum extent possible, steps be taken to ensure that fully alert crews are in charge of dangerous goods trains. (4.38)

Medical Checks for Railway Operating Personnel

- Railway operating personnel continue to be required to take medical examinations at prescribed times and in a prescribed manner as a prerequisite to maintaining their licences. (4.40)
- The process of medical examinations for railway operating personnel be reviewed with that in place for the aviation community to determine areas for improvement, if any. (4.40)
- As an assistance to improving public confidence in the railways, the public be made aware that train operating personnel do undergo prescribed medical examinations. (4.40)

Mandatory Drug/Alcohol Testing

- Rule G, specifying the non-use of drugs or alcohol on the job, or when subject to duty, be maintained and strongly promoted. (4.43)

- Properly advertised pre-employment screening tests for new employees and for those seeking a reclassification to safety related positions be implemented. (4.43)
- Testing for 'reasonable cause' also be implemented but with assurances that employee rights and privileges are not abused. (Reasonable Cause to be defined by the Regulator in collaboration with the railways and the railway Unions.) (4.43)
- Mandatory testing for drug or alcohol usage be undertaken in the case of serious accidents involving death, injury, derailment or collision. (4.43)
- Employee Assistance Programs be promoted and encouraged along with a training program to increase railway employee awareness as to the seriousness of the consequences of impaired actions, especially involving dangerous commodities. (4.43)
- Medical checks on employees involved in safety related positions, such as train engineers, include tests for the abusive use of drugs and alcohol. (4.43)

Human Factor Research and Development

- The human component of the rail system be recognized as a vital and integral part of the total railway system. (4.45)
- Railway manufacturers, management and unions, in any new train cab development or retrofit program, take ergonomics and the human element into consideration. (4.45)
- Research resources be applied to understanding the functioning of the human component. (4.45)
- All research, whether related to human factors or technology, take the impacts on the total rail system into consideration. (4.45)

Training

- Railway training programs, already technically of a high standard, be complemented with motivational and awareness training. (4.47)
- Dangerous goods handling courses be significantly enhanced to include, for example, an understanding of emergency response systems, and to view, through videos and the like, demonstrations involving the consequences of dangerous goods accidents (i.e. fires, toxic gases, explosions, etc.). (4.47)
- Dangerous Goods courses, in addition to the conditions prescribed under the Transportation of Dangerous Goods Act, include an awareness of the consequences such accidents could have on a community. (4.47)
- Dangerous Goods courses, for all railway operating personnel, include simulation and other such testing to help ensure an effective emergency response. (4.47)

- All training courses involve operational personnel more extensively, both in course developmen[illegible]s well as in instruction. (4.47)

Speed

- Since the question of a preferred speed is fundamental to public confidence in the safe operations of trains carrying dangerous goods, an independent, technical review be established to examine our consultants' work with regard to speed. (4.57)
- Since it has been determined that speed is not the primary or major cause of accidents and since it has been determined that accidents are caused by other factors, attention be given to addressing and removing, on an utmost priority basis, the track, equipment, operational and track defect causes of accidents as identified by the Task Force's consultants, in the densely populated urban areas of the Greater Toronto Area. (4.57)
- Research and Development work be accelerated into reducing in-train operational forces, harmonic oscillation, wheel climb, hunting and other such causes of accidents. (4.57)
- The passage of trains carrying dangerous goods in the densely populated urban areas of the Greater Toronto Area be more carefully managed and scheduled in such a way as to ensure that they are not required to change speeds abruptly or unduly. (4.57)
- To the maximum extent possible, physical, geographic and infrastructural impediments requiring undue speed changes be removed. (4.57)

Lack of Research Co-ordination

- The Minister of Transport undertake to co-ordinate the railway safety research program in Canada and from this coordination determine and address the priority of projects, the funding and the facility requirements necessary to ensure its effectiveness. (4.62)
- Since it is acknowledged that the rail system is a North American operation, the Minister of Transport, in conjunction with his/her United States counterpart, undertake to coordinate the railway safety research program in North America. (4.62)
- The Minister of Transport ensure that railway safety research objectives are met on a constant and continuous basis, through the implementation of meaningful projects. (4.63)

Priority Research Projects

- The many safety Research and Development opportunities identified by the Task Force, especially those dealing with the Human Factor, be structured into a co-ordinated and adequately funded program. (4.64)

- It be recognized that safety Research and Development is of vital importance to the ongoing enhancement of public safety, especially those projects affecting the rail flow of dangerous goods in densely populated urban areas. (4.64)

Lack of Adequate and Co-ordinated Emergency Plans

- Emergency Response Plans, properly co-ordinated and consistent between the Municipalities and Regions in the Greater Toronto Area, be made mandatory. (4.66)
- These plans identify specific requirements to respond to railway dangerous goods accidents. (4.66)

Inadequate Communications and the Need for a Single Spokesperson

- Accurate and timely communications be recognized as a vital component in responding to an emergency and be incorporated in the mandatory plans. (4.67)
- Emergency Response communications be improved through properly defined roles/jurisdictions of the responders and through the use of one spokesperson communicating with the public. (4.67)
- Emergency Plans pertaining to the rail flow of dangerous goods in the Greater Toronto Area have input from the two major railways and the chemical/petroleum industries involved. (4.68)

Lack of Public Awareness

- Emergency Plans, and simulation exercises, include a Public Awareness and Education component through the issuance of information brochures, pamphlets and pertinent emergency response data. (4.69)

Lack of Emergency Response Access to Rail Lines

- All levels of government, but particularly the provincial and municipal governments, and the railway industry ensure a full and adequate access to all parts of a railway line carrying dangerous goods in densely populated urban areas without encouraging unsafe trespass. (4.69)
- Provincial and municipal planning guidelines and practices ensure that adequate and sufficient emergency response requirements are addressed to cope with dangerous goods rail accidents in those areas where rail lines are located. (4.72)

Lack of Consistency in Railway Emergency Response vis-a-vis Municipalities

- The railways standardize all their operations as they affect emergency response (i.e. consist documentation, emergency procedures, response team duties and responsibilities). (4.72)

- The railways notify all first responder agencies in the Greater Toronto Area of these standard practices and procedures. (4.72)
- The railways participate with the Greater Toronto Area first responders in simulation exercises, especially involving the rail flow of dangerous goods. (4.72)

Railway Demand on Emergency Capabilities

- The railways and Municipalities in which rail infrastructure (primarily rail yards) exists,mutually agree to an adequate provision of emergency response and an appropriate sharing of costs. (4.75)

Costs and Who Pays

- Operational and infrastructural improvements to the railway system should be borne by the Railways if allowed to do so at a reasonable pace and within the normal maintenance and replacement cycles. (4.77)
- The incremental costs of accelerated programs of railway improvements, or of enhanced levels of public safety in the transportation of dangerous goods in densely populated urban areas over and above that which could reasonably be expected to be borne by an already safety complying, competitive business entity, should be borne by the federal government. (4.77)
- Incentives and encouragement should be given by the federal government to the railways and other agencies as a way of promoting safety Research and Development, recognizing that any funding mechanism must ensure the conduct of relevant and co-ordinated research. (4.77)
- Emergency Preparedness and Response costs to meet the minimum requirements for coping with rail dangerous goods accidents should be borne by the Province of Ontario and/or the Municipalities. (4.78)
- The railways, as a normal cost of doing business, compensate the Municipalities in which rail yards exist for emergency response demands in excess of a mutually agreed level. (4.78)

6.0 Appendices

Appendix A

Terms of Reference

Title

1. This Task Force may be referred to as the *Toronto Area Rail Transportation of Dangerous Goods Advisory Council.*

Interpretation

2. ■ *"Council"* means the Toronto Area Rail Transportation of Dangerous Goods Advisory Council.
   ■ *"Minister"* means the Minister of Transport
   ■ *"Toronto area"* means the Regional Municipalities of Durham, York, Peel, Halton and Metropolitan Toronto.

Advisory Council

3. An advisory council shall be established to be called the Toronto Area Rail Transportation of Dangerous Goods Advisory Council consisting of not more than seven members including the Chairman.
4. The Council shall serve for a period of two years from the date of its appointment.
5. The Chairman of the Council shall be appointed by the Minister.

Meetings

6. The Council shall meet at such time and place in the Province of Ontario as the Chairman requests.

Duties of the Council

7. The Council shall

a) Inquire into and report to the Minister on:
   i) The feasibility of re-routing rail traffic transporting dangerous goods within the Toronto Area;
   ii) The feasibility of relocating rail transportation services carrying dangerous goods within the Toronto area;
   iii) The feasibility of additional requirements governing the transportation of dangerous goods by rail; and

b) specifically, consider and identify:
   i) The direct and indirect economic costs and benefits involved in options from re-routing or relocating rail traffic transporting dangerous goods;
   ii) Other costs and benefits associated with such re-routing or relocating in both qualitative and quantitative terms whenever possible;
   iii) The allocation of all costs involved in re-routing or relocating to those who would assume them;
   iv) The impact on and risk transfers involving communities in the area, shippers and other modes of transportation that may occur as a result of such re-routing or relocation;
   v) The direct and indirect costs and benefits of additional requirements governing the transportation of dangerous goods by rail; and

vi) Methods of proceeding with infrastructure, regulatory or other changes necessary to effect any of the options identified.

Remuneration and Disbursements

8. (1) The members of the Council, other than the Chairman, shall serve without remuneration for the exercise of their duties.

(2) The Minister may, in accordance with the Treasury Board Travel Policy, reimburse the members of the Council, including the Chairman, for travel and other expenses incurred by them in the course of their duties.

Contracting of Consultants

9. The Minister may, at the request of the Council, enter into contracts for conducting special studies considered necessary by the Council for carrying out its functions.

Reporting

10. The Chairman of the Council shall report to the Minister with respect to work of the Council within six months after the establishment of the Council and thereafter at intervals of six months until a final report is submitted.

Appendix B

Toronto Area Rail Transportation of Dangerous Goods Task Force Comprehensive List of Submissions Received

● Telephone or Oral Presentation
○ Written Submission

○		ABC Residents' Association
○	●	Addiction Research Foundation
	●	Mrs. Agar
○		Mr. K.R. Andrews
	●	Association of American Railroads
○		Dahn Batchelor
○		Bayview Fairways Ratepayers Association
○		Beaufort Hills Homeowners Association
○		R. Birch
○	●	Board of Education for the City of Toronto
○		Ms. Carolyn Bonk
○		Borough of East York
○		David Britton
○		Nicole Broughton
	●	D. Burton, Ministry of Transportation, (Ont.)
○	●	Charles Caccia, MP
○		Councillor Joanne Campbell
	●	Canadian Aviation Safety Board (CASB)
○	●	Canadian Chemical Producers Association
○	●	Canadian Fertilizer Institute
○	●	Canadian Industrial Transportation League
	●	Canadian Manufacturers' Association
○		Canadian Standards Association
○		Candis Investment Corporation Ltd.
○		J.L. Cann
○		Neil & Darlene Carson
○		Goodwin Chan
	●	A. Chmielenski
	●	C.J. Churcher, Transport Canada
○		City of Brampton
○		City of Etobicoke
○		City of North York
○		City of Oshawa
○	●	City of Scarborough
○	●	City of Toronto
○		City of York
○	●	CNR (Canadian National Railways)
○		Connaught Laboratories Limited
○	●	G. Cooper, Railway Transport Committee (retired)
	●	W. Copeland
	●	Lee Cousins
○	●	CPR (Canadian Pacific Railway)
○		Mrs. Valerie Cumming
○		Davenport-Perth Neighborhood Centre
	●	Pierre Desperon
○		Mrs. Marina Dorna
○		Chris M.J. Edwards, (Van Waters & Rogers Ltd.)

	●	Telephone or Oral Presentation
○		Written Submission

	●	J. Eisler, Railway Transport Committee (Vanc)
○		Elder Mills Ratepayers Association
	●	D. Ellison, Transport Canada
	●	Emergency Preparedness Canada
	●	Emergency Response (Ont.)
	●	M. Farrow, Ministry of Municipal Affairs, (Ont.)
○		E.B. Freeman
○		Mr. Manuel Frias
	●	R. Gaade, Toronto Fire Dept.
○		F.T. Gerson
○		Glen Shields Community Association
	●	GO Transit
○		T. Goodwin
	●	Joachim F. Gottschlak
○	●	Governor's Bridge Ratepayers Association
○		Betty Hagopian
○		Douglas Haldenby
	●	Mr. Alfred Hare
○	●	A.J. Healey
○		Health & Safety Executive (UK)
○	●	Dan Heap, MP
○		Lyman Henderson
○		Dolf Hiel
○	●	E. Hignell
	●	Alderman Ying Hope,
	●	Humber Valley Village Residents' Association
○	●	Institute for Risk Research
	●	IRRATE (Dr. G. Wetherly)
	●	A. Irving
	●	Mr. C. Irwin
○		David F. Jackson
○		Anne Jankulak
○		Mrs. R.S. Johnston
	●	Mr. John Juniper
○		Ron Kanter, MPP
	●	Stan Kaplan, Railway Transport Committee
○		Kleinburg & Area Ratepayers Association
○		T. Kovar
	●	H.J. Kuhlmann, Metro-Toronto, Roads Dept.
	●	M. Lacombe, Railway Transport Committee (Ont.)
	●	Ray Lambert
○		Leacrest Road Action Committee
○		Leaside Property Owners Association Inc.
	●	G. Little, Ministry of Transportation (Ont.)
	●	C. Lumley, Ministry of Transportation (Ont.)
○		John R. Lundon
○		John Mayell

● Telephone or Oral Presentation
○ Written Submission

○	●	Metro-Toronto Residents' Action Committee (M-TRAC)
○		Mississauga Board of Trade
○	●	Montgomery Road Ratepayers & Residents Association
○	●	Moore Park Residents Association
○	●	Municipality of Metropolitan Toronto
	●	Dr. D.H. Napier, University of Toronto
	●	National Transportation Safety Board (Charles Batten)
○		Neighbourhood Watch Group (Etobicoke)
○		North Morningside Community Association
○	●	North Rosedale Ratepayers Association
○	●	Northern Health Area Community Advisory Board
○	●	Frank E. Nott
○		Mrs. M. Nousianinen
○		Alderman Nadine Nowlan
○	●	Ontario Petroleum Association
	●	Ontario Provincial Police (Dangerous Goods Unit)
○	●	Ontario Traffic Conference (The)
○	●	Ontario Trucking Association
○		Mr. Leo Penzvalto
○		Mde. Louis Rita Pepin
	●	Petroleum Traffic Committee
○		Philip E. Wade & Associates
○		Playter Area Residents' Association
	●	Councillor M. Popovitch
	●	Procor Limited
○		Propane Gas Association of Canada Inc.
○	●	Province of Ontario
○		Patrick Puccini
○		Kenneth Pun
○		Mario G. Racco
○	●	Railway Association of Canada
○		Rathnally Area Residents Association
	●	Alan Redway, MP
	●	Reference Canada
○		Regional Municipality of Durham (The)
○		Regional Municipality of Halton (The)
○		Regional Municipality of York (The)
	●	Mrs. Remiz
	●	Morrison Renfrew, Canadian Institute of Guided Ground Transport
○		Alfred Rigo
○		Councillor P. Robertson
	●	Howard Rowan
	●	Supt. D. Rowland, Peel Regional Police

● Telephone or Oral Presentation

○ Written Submission

○	●	Councillor June Rowlands
	●	R. Sasaki, City of Toronto (Planning)
	●	Mrs. W. Schofield
	●	Hon. Ian G. Scott, MPP
○		South Oakridge Residents Community Association
○		South Rosedale Ratepayers' Association
○		Basil & Irene Spurr
○		Sinclair Stevens, MP
	●	Mr. F. Strang
○		St. Lawrence Neighbourhood Association
○	●	Summerhill Residents' Association
○	●	The Annex Residents' Association
○		The Board of Education for the City of Scarborough
○	●	The Board of Trade of Metropolitan Toronto
○		The Coalition of Scarborough Community Assoc.
○	●	The Markham Board of Trade
	●	Toronto Transit Commission
○		Town of Caledon
○		Town of Markham
○		Town of Milton
○		Town of Vaughan
○		Town of Whitchurch - Stouffville
○		Township of King
○	●	United Transportation Union/Canadian Railway Labour Association (R.A. Bennett)
○		Urban Development Institute/Ontario
○		Vaughan Hydro Electric Commission (The)
○		Vaughwood Ratepayers Association
○	●	VIA Rail
	●	Alderman M. Walker
○		Patricia Wallis
○		Walmer Road Residents' Association
○		Stephen Ward
	●	Mayor J. West
	●	Brigitta Westin
○		Mr. & Mrs. Whitworth
	●	Mr. F. Widonski
○		Windfield's Community Ratepayers' Association
○		Woodland Acres Ratepayers Association
○		Mr. & Mrs. M. Wyches
	●	York Condominium Corp.
○		York Federation of Ratepayers

Appendix C

Foreign Experience
1) Introduction

In the course of our enquiries into the ways of improving safety of rail transportation of dangerous goods shipments in the Greater Toronto Area, the Task Force sought information and experiences from foreign jurisdictions. We did this through correspondence, telephone conversations, site visits and meetings.

Our request for information was initially centered on our rerouting and relocation mandate. We wanted to find out the conditions and circumstances which may exist elsewhere and which may be different from those pertaining to the Greater Toronto Area, Canada and North America. In the course of these enquiries, other information was gathered and provided to the Task Force - some of which was passed to our consultants for their information, consideration and consolidation with their work.

Nine questions were asked of the foreign countries (other than the United States). Four supplementary questions were then asked. Four questions were asked of the States in the U.S.A. Not all countries or States responded. A summary of responses is attached to this Appendix (Tables A1, A2 and A3).

2) Foreign Experience Overview (other than the United States)

The Task Force corresponded with the following overseas countries:

- The Federal Ministry of Transport, West Germany
- The British Department of Transport, and the British Health and Safety Executive, Great Britain
- The Ministry of Transport and the Ministry of Public Housing, The Netherlands
- The Ministry of Transportation and Communications, Sweden
- The Ministry of Transport, Denmark
- The Ministry of Communications, Norway
- The Department of Transport and the Railways of Australia Committee (on behalf of Australian States Railways), Australia
- The Ministry of Transport, France
- Finnish State Railway, Finland
- The Ministry of Transport, Japan

The following is a summarization of the major and relevant information received.

Relocations
With the exception of one siding used for chlorine in the Netherlands, none of the jurisdictions reported that track relocations had taken place with the object of diverting

dangerous goods from densely populated urban areas.

Buffers

With the exceptions of the Netherlands and Sweden, no jurisdictions have dangerous rail routes along which development has been controlled in the interest of maintaining a buffer distance between the railway and the adjacent development. The Netherlands reported that general planning and land use legislation applies in these circumstances. Risk analysis and separation distances are employed in residential development areas.

In Sweden, adjacent development is controlled, in similar circumstances, through local zoning plans and building permits.

Speed

With the exception of the Netherlands and two Australian States, no special speed restrictions are applied to freight trains carrying dangerous goods apart from those restrictions applicable to all freight trains. In the Netherlands, trains carrying chlorine are limited to 60 kph (37 mph). In Queensland, Australia, 60 kph is the limiting speed while in Western Australia, LPG (liquified petroleum gas) cars, without head shields and double shelf couplers, are limited to 40 kph (25 mph).

Marshalling

The manner in which dangerous goods cars are marshalled in trains varies widely:

i) British Rail moves LPG (liquified petroleum gas), flammables, nuclear fuels and HCN (hydro-cyanic acid) in block trains. As origins and destinations are fairly constant and British trains customarily are not as long as those in North America, there are operational reasons for such a strategy. Marshalling separation distances also apply for other dangerous goods.

ii) Norway marshalls dangerous goods cars according to specific regulations.

iii) The Netherlands transports chlorine in block trains whereas other dangerous goods, such as LPG (liquified petroleum gas), moves in block trains only if feasible.

iv) Sweden and Denmark do not have special marshalling regulations. In Australia, dangerous goods cars are generally interspersed throughout the train. Two Australian States however, reported the use of block trains.

Operations

In the area of special operating and technology precautions, these also vary widely:

i) Britain requires special illumination if the last car in the train contains flammable goods.

ii) Norway mandates roller bearings.

iii) The Netherlands reported an emphasis on emergency response, special inspection and enforcement for dangerous goods and a preference for transporting dangerous goods at night when passenger train frequencies are significantly less than during the day.

iv) Sweden requires a two-wagon separation between cars carrying explosives, flammables and pressurized gases.

v) In Queensland, Australia, explosives are not permitted in city centres.

Traffic Volumes

In the Greater Toronto Area, the transportation of dangerous goods rail is approximately 6% of all rail traffic. Denmark and Sweden reported percentages of 5% and 10% respectively whereas Britain reported that approximately 9% of their traffic is dangerous goods.

While in the Greater Toronto Area, where over 100 twin truck car trains are common, freight trains in Britain, Sweden and Denmark typically only contain 35 to 55 twin truck, or twin axle cars.

Regulations

It should be noted that most of the members of the European Economic Community reporting to us, subscribe to the RID[1] regulations whereas Britain subscribes to the recommendations of the United Nations Committee of Experts, a Health and Safety Commission and an Advisory Committee. It embodies such recommendations in its British Rail's Condition of Carriage.

3) Foreign Experience (Great Britain)

The Task Force was able, through its Chairman's visit to Great Britain, to obtain a detailed insight into many aspects of the approach Britain employs with respect to railway and dangerous goods safety - domestically, internationally and as a member of the European Economic Community. Our Chairman's visit embodied a series of interviews with senior officials of Britain's Health and Safety Executive; Department of Transport; Chief Inspecting Officer of Railways; British Rail (Chairman); and British Rail's Research and Development Division.

The information provided was extensive. It has been summarized and is grouped below into main headings, not only for clarity, but also to allow for a better assimilation with respect to the current roles, processes and functions occurring in Canada.

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[1] - *RID - Reglement concernant le transport international ferroviaire des marchandises dangereuses.*

A significant element, not be overlooked, is that British Rail is operated by the Government through a Board of Directors. Its Chairman, and Vice-Chairman, have direct responsibility for all functions - including government relationships and international policy. Part-time Board Members have responsibilities on various sub-committees. In Canada, with the exception of Canadian National Railways to some extent, this proprietorial relationship does not exist, thus providing a distinct, formal division between the Regulator and the Operator.

Roles and Responsibilities

Prior to 1974, each Ministry of Government was responsible for health and safety. However, a Royal Commission recommendation, at that time, arising from a major safety incident investigation, resulted in legislation entitled "The Health and Safety at Work Act" and the establishment of a Commission - The Health and Safety Executive. This Commission was to deal exclusively with the health and safety of the work place and the public safety in all public and private endeavours. It includes representatives of business, labour and local authorities and is assisted by a special Advisory Committee. The Commission reports to the British Parliament. Each Ministry of Government is responsible for responding to the Health and Safety Executive recommendations and enacting appropriate legislation.

An initial inquiry, into the handling of dangerous goods at static hazardous sites, led indirectly to the formation of an Advisory Committee on the Transportation of Dangerous Substances. The first initiative of this Committee was toward road transportation. With the participation of industry and concerned Agencies, a code of practice covering such matters as tank trucks, tank containers, packaging, labelling, loading, manifesting, document location, special precautions and driver training has been developed. Attention is continuing in the road mode but the railways are now receiving consideration. It is not expected that the regulations for rail will be of the same type as road. This is principally because rail authorities have already been pro-active in the area of safety - resulting in the generation of public confidence and little pressure for rail safety improvement.

Buffer Zones

These have been in use for some time at static sites. The Health and Safety Executive Commission provides technical advice to local authorities with implementation being left to them. Detail requirements are determined as a result of risk analyses (see Risk Analysis below).

Designated Dangerous Goods Road Routes

Designated dangerous goods road routes have not been mandated. By-laws, attempted by the City of London Council, were not approved by Government. This has however, led to the planning of dangerous goods road movements, by voluntary agreement, between shippers and local authorities.

International Shipments

Responsibility for international marine shipments remains with the Department of Transport which, as Britain's representative, also co-ordinates the formulation of United Nations regulations. The Health and Safety Executive is also required to consider the UN-International Maritime Organization regulations, as they apply to Britain.

Britain is a voluntary party to the international agreement and regulations for road transport (ADR)[1] and rail transport (RID) and strongly endorses their adoption. International agreement on standards, at least on minimum standards, is considered essential to cope with and not hinder, the considerable traffic between the European Economic Common Market countries.

Risk Analysis

This type of investigation started in Britain in the nuclear field. It has now become, through experience, a recognized form of assessment and comparison by safety inspectors. Although there have not been any serious nuclear and dangerous goods releases to date, industry uses the analysis extensively to improve their operations and community relationship. It is recognized as being a comparison tool only.

A representative of the Health and Safety Executive, which, by the way, is further developing the risk analysis process, visited Canada and took time to confer with the Task Force and its 'Risk' consultant - Concord Scientific Corporation. The Health and Safety Executive is now initiating this form of analysis for rail transportation applications.

While there is international cooperation in the field of risk analysis, it is gratifying to learn that the approaches used by the Task Force are similar to those used elsewhere.

Emergency Response

Approvals for handling of dangerous substances by industry are dependent upon the preparation of emergency response plans. This applies to the static site proponents as well as to the local authorities. Health and Safety Executive inspectors review all such 'handling' and sites in the course of their work.

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[1] - *ADR - Accord européan relatif au transport international des marchandises dangereuses par route.*

Railway Accident Investigation and Inspection

The British Rail Inspectorate was established in 1840, by an Act of Parliament as a result of a series of rail accidents. At that time and up to the 1950s, the British railways had been independent of government and were privately owned. The Inspectorate is a part of the government and essentially monitors the railways' responsibility for rail safety.

Initially, the Inspectorate's role was to investigate rail accidents, but in 1871, this role was broadened to include regulatory responsibilities. These responsibilities were limited to specific safety practices, such as signalization, where approvals were required of the Minister of Transport. Regulation responsibilities do not include rolling stock unless as the result of an Inquiry.

It was stressed that the Inspectorate must not only be independent but it must also be seen to be independent. To achieve this, the Inspectorate personnel were initially drawn from the Army Royal Engineers and seconded to the Board of Trade. This practice lasted until the turn of the century. At present, the Inspectorate remains as an independent body with a lot of internally - developed staff.

The Inspectorate has generated public confidence through its activities and expertise and through its objective dealings with British Rail. The Inspectorate stays abreast and ahead of technology developments and reviews safety monitoring reports and practices with senior directors of British Rail, on a semi-annual basis.

The Inspectorate utilizes external experts and union representatives. On occasion, external enquiry officers are also appointed when it is felt that the Inspectorate may be in conflict with its earlier efforts to encourage specific safety initiatives.

The Inspectorate feels that the British approach to rail regulation and inspection is effective, resulting as it has in the generation of public trust over such a long period of time. The Chief Inspector pointed out that the Netherlands employ a similar system; that Swedish Rail is largely self regulated; while, in France, railway regulations are legally binding - with criminal consequences for infractions.

The Inspectorate considers that a significant advance can be made in further safety developments if human factors and responses are included in the process of technology and operations development.

Research

Co-ordination of research on the international scene is accomplished through UIC[1]. However, this is only at the Committee level. Direct cooperation on research would depend on intergovermental agreements. Rail research, on the national scene in Britain, is centered in the British Rail's Research Division. Division staff number 750, with an annual budget of 16M British pounds ($36M). They are organized into disciplinary and functional fields. While British Rail's Board of Directors controls all work, 75% of the project budget is managed by business groups oriented to functional and industry projects. The remaining 25% is allocated for exploratory, or longer term, projects to maintain British Rail in the forefront of railway engineering development. An important source of research project identification is from the Inspectorate of Railways (their safety inspection and investigative activities) and from the Board's own Committee for Safety (composed of senior staff and public representatives). However, human behavioural research projects are currently handled by consultants. This latter aspect is becoming more integrated with technical research and the British Rail's Research Division will soon be acquiring staff to work with the operations and medical sections.

Unlike most North American interests, the British and European railways direct their research towards higher speed freight services so that these movements can blend with their passenger operations which account for 75% of their business. They stress flexibility and inter-modal operations especially between ship/truck/rail. Safety aspects of research are governed by the philosophy that all substances should be carried in a safe manner, rather than to refuse carriage.

British Rail and Dangerous Goods

Although only about 9% of British Rail freight is dangerous goods, the chemical industry expects British Rail to possess the necessary and special expertise for such movements rather than British Rail's regulations precluding their acceptance for carriage. The mix of freight and passenger operations at speeds in the 60/65 mph range necessitates a certain sophistication of design and operations which benefits freight and especially dangerous goods. This manifests itself in high infrastructure and control standards necessary to accommodate passenger services.

With respect to rolling stock, the 'Private Wagon Association' works very closely with British Rail operations to ensure achievement of acceptable standards in tank wagon design. This cooperation is also extended to the development of standards for wagons, in international service, under the RID regulations.

[1] *UIC - Union internationale des chemins de fer.*

4) Foreign Experience (United States)

The Task Force made general enquiries of fifteen States in the United States and, on specific lines of enquiry, also visited the Cities of Chicago, Illinois; San Antonio and Houston, Texas; Cambridge and Boston, Massachussetts; Washington, D.C.; and the Association of American Railroads' Test Facilities near Pueblo, Colorado.

The fifteen States mentioned above were Michigan, New York, Illinois, Missouri, Washington, DC, Washington (State), Pennsylvania, Ohio, New Jersey, Idaho, Oregon, Maine, Texas, California and Louisiana. Several officials were contacted and, in some cases, specific documentation was exchanged. Although some States did not respond, the majority of opinion was that, while there was some concern amongst citizens over dangerous goods transportation, there was very little concern (3 States out of 12) over the rail mode. Most citizens were concerned with the transportation of spent, and unspent, nuclear fuel. This was followed by concern for the road transport of dangerous goods.

At the State level, a similar minimal degree of concern with rail transportation was expressed (2 of 12). In addition, two States expressed concern with the degree of enforcement and two States had concern with emergency response readiness.

Apart from State railway inspection initiatives, exercised through a funded program with Federal Railway Administration (in addition to its own in-house activities), only two out of twelve States, are taking any ongoing action. These are in the emergency response area, for one, and in a continuous rail monitoring role, through a task force, in the other. In addition, three States have only studied the subject whereas one State reported that an American Association of State Highway and Transportation official would be starting studies - commencing with the nuclear waste transportation.

The Task Force's Chairman visited Washington, DC where he met with the Administrators of the Federal Railroad Administration (FRA) and of the Research and Special Projects Administration (RSPA). He also met with the President and senior officers of the Association of American Railroads (AAR).

In addition to the Cities mentioned above, the Task Force visited the Research and Test Department of the Association of American Railroads in Chicago and in Pueblo, Colorado, and the Transportation Systems Centre of the US Department of Transport's Research and Special Projects Administration, in Cambridge, Massachusetts.

Federal Railroad Administration (FRA)

Federal Railroad Administration (FRA) and Research and Special Projects Administration (RSPA)

In 1966, the US Government concentrated all regulatory responsibility for railroad safety with the Federal Railway Administration (FRA). In 1975, in appreciation of the hazards inherent in the transportation of dangerous goods by all modes, a concentrated responsibility for this aspect of safety administration was vested in the Research and Special Projects Administration (RSPA) reporting directly to the Secretary of Transportation. Concentrating central agency involvement thus not only reduced duplication of objectives, research, development and test activities, but it also permitted a balanced multi-modal perspective.

Timely communication with the public is considered a high priority. It also allows for the opportunity to exhibit ownership of regulations by various Government Agencies. These Agencies receive many inputs to rule making from groups such as the railways; the AAR supplier/producer industries; and from the FRA staff as well.

The Federal Railway Administration has not taken a position on speed with respect to dangerous goods trains. Resolution of this issue has been left to local Municipalities, States and the US railroads. States have varying 'constitutional' powers (junior to the Federal authority) as do shippers and carriers under interstate commerce legislation.

Official interest in the safety aspects of transporting dangerous goods is expressed through three groups reporting to the Secretary of Transportation. These groups are:

- A Task Force reviewing a Report prepared by the General Accounting Office (GAO);
- A Special Task Force, convened by the Secretary; and
- A hazardous goods advisory group.

Some of the findings which have wide acceptance are:

- Every community should have a good emergency response system with special training and information programs;
- Communities should be financially assisted in emergency response costs through a special tax;
- Shippers (and carriers) should be classified;
- Rail and truck traffic rerouting should not be overlooked nor should the impacts on commerce.

In specific technical areas, the Federal Railway Administration, has delegated authority, such as for tank cars, to the Association of American Railroads (AAR). The FRA has high regard for the AAR process and achievements, which, from time to time, it reviews. Delegation can be withdrawn. Nearly all tank cars are leased, and the liability aspect of tank car leasing, is an encouragement to high standards. Pressure safety factors (to a factor of five) are used for pressure-test design for the more dangerous products.

The National Transportation Safety Board (NTSB) is a multi-modal Agency which reports to Congress and investigates accidents with respect to all safety matters. Economics is not a consideration. NTSB staff offered the opinion that the severity or consequence of rail dangerous goods accidents increases with speed. They had no observations on accident frequency coupled with this speed factor. They were, of the opinion however, that speeds in the 15 mph range should be avoided.

Transportation Systems Centre (TSC)

The Transportation Systems Centre (TSC) is part of the Research and Special Projects Administration (RSPA).

The Task Force met with the Centre's Director and senior staff. The Centre is a multi-modal Agency which can only function within areas of Federal jurisdiction and which responds to modal Agency budgets. Unlike the period before the mid 1970s, it is not permitted to undertake work for industry.

The Centre is organized into an Office of Administration and four technical divisions:

- Research and Analysis
- Operational Engineering
- Operational Assessment
- Technology Applications

The latter division was the one which undertook development and testing of head shields.

The Centre enjoys a close relationship with the FRA, through the RSPA, but due to limitations on being able to work outside government modal Agencies, it is not able to associate itself as closely with the AAR as it would like. While a Memorandum of Understanding exists with Canada to provide for cooperation, the Centre only has a casual relationship with the National Research Council and the Transportation Development Centre in Canada. Similarly co-operative work with Britain, Germany and France has not been pursued recently.

There is interest in human factors research. The Centre has developed harmful substance detection systems through the services of one specialist on staff but such research was not active at the time of our visit. Another Centre interest is to determine whether there is any growth in hazmat transportation.

A project-needs analysis indicates that there is significantly greater concern over environmental issues than for hazmat transportation. Concern for nuclear waste transportation is also greater than for either of the above where little concern, in fact, exists.

Since the development of the tank car head shield, the Centre has been working on tank car failure mechanisms specifically for chlorine cars. Its report will be submitted to the FRA. Test designs, for aluminum tank cars, were also underway. The Centre would like to extend this series of tests to high strength steels.

Association of American Railroads (AAR)

i) Washington, D.C.

In the interest of avoiding conflict, the AAR would have no problem with an independent body setting standards for safety. However, it would be difficult and extremely expensive for such a body to maintain effective expertise in the technical fields (above the 'state of the art' level) as most major expertise resides with either the railroads or the AAR.

The AAR's five year research planning cycle, with annual updates, has been changed from an emphasis on energy conservation and efficiency to the operating fundamentals of railway - such as braking systems, signals, and communications. Research and Development by suppliers is considered below average but the US Government is doing Research and Development related to safety.

Research emphasis will move to two major areas - Risk Assessment and dangerous goods ratings, or safety predictions. At present, the AAR feels that railways are 90-95% safe. Although improvements will continue to be made, individual achievements are becoming relatively more expensive. Currently, a cooperative task is underway with the Railway Progress Institute (RPI) on materials testing.

Priority setting for projects is undertaken by the AAR with input from suppliers, carriers and the Government. Results of research are published, yet it is up to each AAR member, or associate, to implement these findings. The FRA, or the Canadian Transport Commission (CTC), can embody the research and issue regulations. Proprietary work remains the property of the proponent.

Concern was expressed as to the continued viability of the

Transportation Test Centre (TTC) in Pueblo, Colorado. It was felt that it was important to test new initiatives thoroughly before commercial introduction. As an example, AAR officials quoted the probability of heavier axle loads being employed as the carriers searched for greater productivity. If not fully evaluated, at a facility such as the TTC, serious consequences could result which would render the carrier non-competitive and the railway system less safe.

ii) AAR Research and Test Laboratories - Chicago, Illinois

The Task Force had the opportunity of inspecting the AAR test facilities in Chicago, but time did not permit a visit to the 47th Street Track Laboratory.

This Research and Test Department resulted from the amalgamation of the Research and Development divisions of each of the AAR Departments. A wide variety of projects are underway on such matters as infrastructure above subballast, on equipment and on materials. The Department undertakes proprietary testing for suppliers but does not do design work. It does however, provide advice on performance and practices. Specifications, resulting from tests and other supplier activities, are developed by the AAR.

The Research and Development Department undertakes certification testing of components, submitted by suppliers, as well as of manufacturing plant facilities, processes and quality control.

The AAR does not automatically become involved in accident investigations. However, they do posses the largest concentration of railway knowledge in North America and consequently get invited to participate in many accident investigations.

A tank car safety project presently underway is being undertaken in cooperation with Railway Progress Institute (RPI) to which all tank car manufacturers belong. The objective is to further reduce lading loss and improve tank integrity. Current priorities, in this area, are in the studies of steel metallurgy and brittle fracture.

The FRA and the AAR cooperate on performance monitoring, including the review of all repair dockets carried out in certified shops. However, it is felt that more detailed reporting is required relating to the tank car damage causes.

In this area particularly, the AAR feels that public perception of safety initiatives was very low. Their Research and Test Department budget was estimated at approximately $22 million for 1987 which includes their Washington Systems

Centre. The final distribution of expenditures (in percentage terms) for 1985, was quoted as:

Category	%
Freight Train Equipment	29.0
Track and Structures	23.0
Vehicle/Track Interaction	16.3
Freight Equipment Management	8.0
Train Control Technology	7.5
Employees Safety	3.0
Environmental	2.3
Productivity	2.3
Other	9.6

The anticipated return on Research and Development investment was quoted as 8 to 1. The need for the rehabilitation of railway bridges was seen as a future issue, possibly requiring large sums. Employee behaviour; emotional and job stress; and harmful substance abuse were not being addressed by the AAR.

iii) AAR Transportation Test Centre - Pueblo, Colorado

The AAR's Research and Test Division has a staff of 340, functioning through three sections. Programs are set and activities are co-ordinated through the AAR's executive. This does not however preclude an individual R & D Section from interfacing with external organizations such as the FRA, the Research and Special Projects Administration (RSPA), supplier and shipper industries, and/or academic and research institutions. The three sections are:

- Washington Systems Centre (WSC) - dealing with such matters as management, operations and economics.
- Chicago Test Centre (CTC) - dealing with such matters as scientific, design test and qualification tests.
- Transportation Test Centre (TTC) in Pueblo, Colorado - dealing with such matters as systems and component field testing/development and hazard material training.

TTC (unlike its sister Centres, the CTC and the WSC which are fully funded by AAR's members), is a quasi-commercial operation carrying out assignments on a breakeven basis. Some assignments are cost plus a fixed fee. Other projects may just be a fixed fee. Through their membership in the AAR, Canadian railways contribute to the AAR's general revenues (less the legislative portion of costs which pertain to the U.S.A. only) and participate in all test programs. The only direct involvement to date, has been in the hazard training area. The TTC will undertake services for any client; does not publish reports unless requested to by the client;

and undertakes some work on a proprietary (commercial confidential) basis.

Results of proprietary testing are sometimes shared but only with the client's permission. The TTC is recognized as the only facility of it's kind in the Free World. A Swedish facility consists of a test loop only while the Chinese are considering a facility of their own. The TTC has no long term funding guarantee from anyone. Its deficit, usually accepted by the AAR's members, currently stands at $250,000. (estimated to be $400,000. by year-end 1987). The TTC 1987 budget is $12 - $13M. The AAR's total Research and Test budget is about $17 - $18M. The TTC budget consists of revenues from:

- Research and Test Department program ($3.5 Million)
- Operations & Maintenance Department ($ .5 Million)
- The FRA ($6 to $7 Million)
- Railroad Supplier Projects (including proprietary testing) ($2 Million)

The AAR also funds academic research through the Massachusetts Institute of Technology; the Illinois Institute of Technology; the University of Illinois and the Carnegie Mellon Institute.

Research is not well co-ordinated between various parties having an interest in rail but the level and degree of co-ordination has improved over the recent past. The AAR has been reasonably successful in maintaining this co-ordination although duplication still exists. Within Canada, the AAR's co-ordination exists with the Railway Association of Canada (routine exchanges), the National Research Council, B.C. Rail, Canadian Pacific Railway and the Canadian Institute for Guided Ground Transport. The AAR has an exchange program with British Rail, Brazil and Mexico. No such arrangement exists with Japan.

The TTC staff is presently around 200 persons:

- 1/3 employed on facility maintenance;
- 1/3 employed on operations such as fire, security, locomotive and rolling stock maintenance and operations; and
- 1/3 employed on test management, equipment fabrication and installation, instrument installation and calibration, and tests operation and reporting.

In the middle to late 1970s, the TTC facility staff numbered about 650. Currently, the TTC is under-utilized.

The Pueblo facility was opened in May, 1971 at a cost of $70M. The original intention was for the operation of a high speed test facility for guided ground transport (principally passenger) and included tracks for air cushion and magnetic levitation vehicles. This was in addition to facilities for conventional flanged steel wheel on rail. In 1974, the facility became the Transportation Test Centre of the FRA. In 1981/82, the U.S. Government reduced FRA's funding and in October, 1982, it signed an operations and management agreement with AAR. Since the AAR has taken over the TTC, additional facilities have been added (e.g. the FAST track loop and connecting tracks, and the hazmat training school and facilities). Additional connections and/or tracks are contemplated. The facility is now valued at approximately $100M.

Although research programs have relatively high returns on investment (ie. 5 - 10 to 1), initial expenditures are also high thus causing research to be too frequently driven by crisis. Much research can be done but the controlling factor, in the absence of obvious need, is economics.

The AAR feels that railways will continue to erode over the longer term unless a research program, proportionate to need, is maintained.

With respect to Standards, it was stated that these appear to have a legal connotation but are, in reality, only bench marks. They do no ensure that the object, or item specified, is adequate for the results expected. More work needs to be done on the system as a whole. Co-ordinating the performance and design of each element in a systems approach (e.g. equipment as well as track) is seen as a requirement. The ultimate would be to achieve an integrated train, infrastructure and operational integrity.

An example of some of the capabilities of the TTC are outlined below. The TTC is however, prepared to undertake any research and test function.

Capabilities

Locomotive:	Dynamometer testing, suspension and control. On-board data collection.
Vehicle:	Modelling, track vehicle dynamics, ride performance, certification, automatic identification, fatigue, aerodynamics, trucks, lading (including securement) and maintenance technologies.
Track:	Track performance monitoring, track/vehicle systems, construction/maintenance, track degradation, track geometry standards,

compact footing and wear, rail metallurgy, vehicle performance on track deficiency/ track types/ track buckling/ and track pull aparts.

Other: Hazmat training and tests, torch fire site, explosive tests, drop tests, rail/highway impact, train/train impact, derail simulations, fire safety and highway vehicle testing (intermodal).

The Task Force visited the facilities and noted that a number of field tests were of a proprietary nature - some with railway funding while others were being carried out with FRA funds. No Canadian National Railways, Canadian Pacific Railway or Canadian Government projects have been undertaken at the TTC although Canadian railways do participate in funding AAR's initiatives through their AAR membership.

City and State Visits

i) Chicago, Illinois

The Task Force met with a representative from the Office of the Mayor and senior departmental officials. An official of the Illinois Commerce Commission also attended at the City's invitation.

The State has legislation relating to Federal Rail legislative provisions and participates in the rail hazmat inspection program with 3 hazmat and 4 rail inspectors. The FRA has sixteen rail inspectors in Illinois. Thirty-five railroads operate in Illinois of which twenty-three are rated as Class 1 or 2. Approximately 10% of freight is hazmat. The number of truck safety incidents were considered to be greater than for rail.

City of Springfield undertook a rail relocation study, with the FRA's assistance, with the objective of rerouting trains for hazardous material reasons. Public interest however, centered on grade crossings, noise and vibration and not on hazmat transportation. The study was eventually abandoned. Staff felt that this was not inconsistent as environmental issues appear to predominate over rail accidents.

The Chicago Fire Department felt that 'relocation' was not a practical solution for Chicago due to its impact on industry and on the City. It felt however, that transportation of hazmat materials was not safe, especially by truck. Rerouting; the timing of movements; and the effective emergency response capability were considered the current paths to pursue.

It was pointed out that the Federal Conference of Mayors and National League of Cities was examining numerous issues, including hazmat transportation, and was planning to approach Congress. However, the Cities are not being able to achieve a concensus and there is similar division of opinion at the State level.

ii) San Antonio, Texas

The Task Force met with an Alderman prominent in safety and security matters, and with the Fire Chief and his officials.

Having been the site of a recent hazmat accident resulting in a product release in June, 1986, the Task Force was keen to hear of this most recent experience. The Fire Department outlined the response process from the initial response of a reported fire hazard accident, through to product identification; expert consultations; specific action plan formulation; public information; evacuation; and restoration. The importance of there being a single, on- scene commander; a comprehensive public information system; specific action plans, formulated with expert advice; and support of elected officials were all cited as major positive aspects of the response action. Some residents want hazmat diverted from the area, but the elected officials feels that that is not realistic. Additional safety measures and effective response are considered practical solutions.

The City of San Antonio is concerned with the hazmat transportation by road. It is also concerned with the lack of specialized knowledge level of those not on emergency response teams - such as citizens, patrol personnel, doctors, teachers, politicians, and, business persons, thus indicating a need for a broad public education, if errors, however well-intentioned, are to be avoided.

iii) State of Texas

The Task Force met with representatives of the Texas Water Commission and the Texas Railroad Commission (TRC).

The Water Commission is primarily charged with the preservation of water supplies and investigates all matters such as spills, runoffs and sewage disposal. The Commission only acts to assume control in the case of an emergency and in the absence of a responsible Municipal official. It works with the Railway Commission when requested.

The Texas Railroad Commission (TRC) was originally formed in 1891 to deal with commercial carrier regulations and oil drilling concessions, licensing, distribution and refining. The transportation function is currently centered on safety since the U.S. Staggers Act on deregulations. It has ten rail inspectors who carry out a cooperative program with the FRA and who report incidents directly to the FRA. The State attempts to issue safety procedures in areas not covered by Federal law. They expect the State's caboose law to be challenged and overturned as being beyond their jurisdiction but they feel the end-of-train unit to be a reasonable substitute. The running speed of trains is approximately 40 - 50 mph. In San Angelo, Texas, which has 'home-rule' legislative authority, the speed of trains has been reduced, by the municipality, to 12 mph in the interest of public safety at grade crossings.

The State has performed a study of truck versus rail safety. Rail is considered twice as safe on a 'tank by tank' basis. Liquid Petroeum Gas (LPG) trucking is highly regulated. Operators are required to qualify, and requalify, every five years and trucks are inspected up to three times annually. Regulated truckers are thought to be comparable with railways as to their safety record. Data on 'unregulated' truckers is hard to obtain and safety is questioned.

iv) Houston, Texas

The Task Force met with City of Houston and some FRA representatives hosted by the Port Terminal Railroad (PTR) Association.

The PTR Association represents eight railroads and provides switching and transfer service to 152 industries on the ship channel. It has 141 miles of track, 500 employees and handles 500,000 cars annually to one of the largest concentration of chemical industries in the world.

Prior to 1980, the PTR had the worst safety record in the U.S.A. and was threatened with closure by the FRA. In 1980, the new General Manager introduced a program directed at safety, training, staff assistance and plant and equipment upgrading. He also introduced a cooperative program with the City of Houston and communities - directed at safety planning and interdependence. This total program was undertaken with PTR staff cooperation. The following sequence of priorities were enunciated for the Task Force:

- **Safety:** Management owes this to staff (and community).
- **Efficiency:** Management owes this to clients with a high level of readiness, reliability and services.
- **Economics:** Management owes productivity and competitiveness to PTR owners.

Insistence on adherence to safety rules, combined with the new program and attitudes, generated such gains in safety that PTR won two gold and three silver Averill Harriman Awards. This was done while still achieving a 22% gain in productivity.

Relationship with the City of Houston is achieved through a full time PTR co-ordinator who is responsible for maintaining a relationship with City departments and communities. The City sees the acquisition of new industries, and the continued improved service to those already existing, as a priority. It views the service, provided by PTR and its members railroads, as 'an asset' in attracting such industry.

v) Boston, Massachussetts

The Task Force met with the Commissioner of Transportation and senior officials of the Police, Fire, Policy and Planning, Office of Special Hazards and Health and Environment Departments.

Residents are concerned with hazmat transportation but mainly by truck. Hazmat transportation is banned from using the 2,500 ft. tunnel and from using City streets from 6 a.m. to 8 p.m.

Rail routes, which handle hazmat material, are outside the City of Boston, except for one intermodal yard where chlorine is handled. The yard is however, located between two highways.

In an emergency, the Fire Department acts as the on-site commander with support from the police. The Public Commission has an Emergency Plan. The Health Department and hospitals act, in a support role. Reliance is however placed on outside experts, if a spill occurs.

5) Major Foreign Experience Findings

- No rail relocations have been effected overseas, or in the USA, for trains carrying dangerous goods through populated areas. In the USA, relocation is not considered a practical solution.
- Probably as a consequence of rail lines not having been relocated, there is no application of buffer zones of compatible development between new routes and residential developments. However, the Netherlands did report the use of planning and land use legislation to apply set backs for residential developments.
- With the exception of USA, where some speed restrictions are in affect for public safety at grade crossings, no speed restrictions for dangerous goods trains are in effect in the majority of foreign countries polled. In the Netherlands, trains transporting chlorine are limited to 60 kph (37 mph).
- Due to the nature of rail operations in England (characterized by trains with fewer wagons, which themselves are smaller than those in common use in Canada), some danger-

ous goods are transported in block trains. Similar operations occur in the Netherlands while two Australian States report some use of block trains. With greater capacity trains in use in Canada and with the longer distances encountered in this country, there does not appear to be a case, for this type of strategy.

- Consideration of human factors is not commonly considered in the planning and designing of operations and/or technology. The consensus however, supports this as an area worthy of attention.
- Citizens in the USA, are more concerned with environmental matters and nuclear radiation leaks than with the transportation of hazardous materials. This may indicate a basic lack of knowledge as has been pointed out by some respondents.
- Rail is widely considered to be safer than trucks but the basis of comparison is not clear. Some comparisons are made on the basis of equal quantities while others are based on a per shipment basis or on a consideration of the severity of accidents.
- In the USA, States have almost no authority over railways. This is an area where Federal law is dominant.
- Most of the USA States consider emergency response planning to be an important factor.
- Although Canadian railways, as full members of the AAR, participate in the AAR's research activities, there is no active, co-ordinated research program, or technical exchange, between the two countries. Considering the capital resources available within the AAR; within the Canadian and USA Governments; and within other institutions of both countries, this lack of co-ordination is surprising.

Summary of Foreign Experience Responses Tables

Table A1
Summary of Foreign Experience Responses

(United States)
Note: Three states did not respond.

Questions (abbv.)	**Michigan**	**New York**	**Illinois**	**Missouri**	**Pennsylvania**
1. Are you aware of citizen concerns re: Transp. of DG by rail?	no	no	no	no	Very little with rail. Road transp. is of concern.
2. Is there concern at the State level?	Location of Manifest & Ident. of product	No. FRA is responsible	No. FRA is responsible	no	Yes, but with road transp; None with rail. Feels rail safer than road.
3. Have/will any steps been/be taken to render rail transp. safer?	DOW interface with railways & public to explain operation	State has fed. leg. embodied in State Statutes and inspect railways. Feds pay 50% of costs	See N.Y.	AASHTO starting study of nuclear waste transp.	no
4. Has the subject been studied	no	no		See above	no

Ohio	New Jersey	Idaho	Oregon	Texas	California	Louisiana
Yes. After Miamisburg	no	no	Yes	no	Yes - response	Not overly so
YES. Gov. appointed TF. Report forwarded.	YES - FRA has responsibility, but not satisfied with level of enforcement. Main concern is hazardous waste.	Resource not justified	Yes	no	Yes - response. No rail authority. Feels rail operation is safe	Same
TF. is standing appointment.	Embodying Fed. law into State law for State enforcement with 50% aid. 42 Hwy inspectors. 4 rail	N/A	Have no rail authority	no	Only in the response area	State DOT & FRA inspections. No more initiative mentioned.
Yes. By TF.	Yes. By TF.	Safety is objective but no specific action contemplated	Have undertaken response coordination & planning study	Hauling DG's is way of life in Houston	No. Feels rerouting and relocation not practicable.	No

Table A2
Summary of Foreign Experience Responses

(other than the United States)
(Original Enquiry)
Note: All countries did not respond.

Questions (abbv.)	Britain	Norway	Netherlands	Sweden
1 Any Buffer Zones?	no	no	no	no
2. Any restricted speeds (urban)?	no	no	Speed appropriate for eqpt. & track. Chlorine limited to 60kph (41mph)	Not for DG specifically
3. Any mitigating measures?	Special packages and containers. If last car (flammable) then tail lamp needed.	no	Regulations apply	-
4. Any special DG precautions?	no	Roller bearings spark protection	Trained response. Special police enforcement units for DG's. Departure in-spections. Generally DG transported at night when passenger trains not running.	On trains 2 wagon separations between explosives, flammables, pressurized gases.
5. How are DG cars assembled in trains?	LPG, flammable, nuclear fuels, HCN-Block trains	Special locationing - no special cars	Special trains used for chlorine (block trains). Other DGs (LPG) transported in block trains if feasible.	DG not transported in special trains
6. Is rail safer than road?	Truck incidents more/severity - less	Yes	No evidence either way.	Subjectively rail safer than road.
7. How are Buffers protected	N/A	N/A	Wide range of measures. (see Q1?) Planning & land use legislation applies and risk analysis and distance measurements for residential development used.	Zoning & building permits
8. Has any relocation taken place?	None	None	One. Siding used for chlorine being relocated away from residential area.	no
9. Who paid?	N/A	N/A	Re: Q8?, the cost is borne by the Municipality, 2 Ministries, the industry in question &the state railway	-

	Australia				
Denmark	**State Rail**	**Victoria Rail**	**Queensland Rail**	**Westrail**	**Australia National**
no	no	no	no	no	no
No - 100kph normal. Infrastructure restrictions could apply.	Limited to rail/ stock - 80kph	Limited to rail/stock	60kph	40kph for LPG w/o double shelf coupler & head shields	Limited to rail/stock
no	no	no	Explosives out of town centre - no petrol storage	no	no
No. Are considering inspection of DG wagons.	no	no	no	no	no
DGs can be carried on any freight -not passenger ferries. DG wagons are separated in train. Subscribe to RID.	Some block, mostly interspersed.	Some block, most interspersed.	Interspersed	Interspersed	Interspersed
Subjectively rail safer For road, transport routes are designated	Yes	Yes	Yes	Yes	Same
They are not.	N/A	N/A	N/A	N/A	N/A
no	no	no	no	no	no
-	N/A	N/A	N/A	N/A	N/A

Table A3
Summary of Foreign Experience Responses

(other than the United States)
(Supplementary Enquiry)

Questions (abbv.)	Britain	Sweden	Denmark
1. What are the quantities of DGs and NDGs transported?	Frt. wagon miles, 366 m. DG/NDG ratio under reply.	DG is about 10% of total of 32.3 MT. Of DG about 1/2 is flammable liquids.	5% per year or 15000 car loads are dangerous. Train percentage not quoted.
2. What proportion is transported through built up areas?	Don't know, but there are no routing restrictions.	Nearly all.	No distinction.
3a. What is wt. of Dangerous goods car & typical load?	Gasoline 105 LT LPG 80LT	25T 4 axle wagons with GW 80T.	TCs weigh 50T, wagons 20T. No typical load wt. available.
3b. Is there a significant difference between gross wts. of cars transporting NDG?	Most DG in block trains as (3a). Box car commodities in wagons 4 wheeled 45 LTGLW.	Tank Cars are about 10-15% heavier than box or flat cars.	No significant weight difference
3c. What are typical lengths of freight trains?	Block trains are typically 12-16 100LT wagons. Ore trains - 3000 LT.	630m, 50-55 2 axle or 30-35 4 axle wagons. Length of trains dictated by power and profile. Usual wts. are 900, 1300, or 1800T. DGs are not transported on block trains.	Typical lengths of freights, 500-600 m. with maxium of 855 m.
4. Is there a quantity or length restriction for DG trains?	No other than for signal, siding No. and traction. Incompatibles subject to separation distances.	No	No